

NASA Astrophysics

ASTROPHYSICS ADVISORY COMMITTEE

October 19-21, 2020
Virtual Meeting

MEETING MINUTES



Charles Woodward, Chair

HASHIMA HASAN

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Hashima Hasan, Executive Secretary

Astrophysics Advisory Committee Meeting Minutes, October 19-21, 2020

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Monday, October 19

Introduction and Announcements

Dr. Hashima Hasan, Executive Secretary of the Astrophysics Advisory Committee (APAC), opened the virtual meeting by welcoming the Committee members. Dr. Hasan then reviewed the Federal Advisory Committee Act (FACA) rules. As APAC is a FACA committee, this meeting was open to the public, and there would also be opportunities for public comment; members of the public were asked to submit questions via the WebEx chat feature or the web portal in the Federal Register Notice (FRN). Minutes were being taken for the public record. All statements and discussion were on the record. Each APAC member has been appointed on the basis of his or her subject matter expertise and must comply with Federal ethics laws applying to Special Government Employees (SGEs).

Dr. Hasan noted that a number of APAC members had conflicts of interest (COIs) with specific topics on the agenda: Drs. Margaret Meixner, Louis-Gregory Strolger, and Michael Meyer on James Webb Space Telescope (JWST, or Webb); Dr. Massimiliano Galeazzi on HaloSat; and Dr. Suvrath Mahadevan on Swift. These members were required to recuse themselves from discussion during the presentations for which they were conflicted. Any questions related to ethics should go to her. Dr. Hasan then introduced the new members: Drs. Manuel Bautista, Ryan Hickox, and Lou Strolger.

Dr. Charles Woodward, APAC Chair, welcomed the participants. He asked APAC members to identify potential findings and recommendations for the written report, and to review the materials provided to facilitate the Government Performance and Results Act Modernization Act (GPRAMA) discussion that would be held on the second day of the meeting. He then introduced Dr. Paul Hertz, Director of NASA's Astrophysics Division (APD).

Astrophysics Division Update

Dr. Hertz thanked Dr. Woodward and the APAC members. APAC is the sole advisory committee giving advice directly to APD. He acknowledged the service of the two members whose term on the Committee would end in September 2020, Drs. William Jones and Asantha Cooray, and welcomed the new members.

APD is one of six divisions within the Science Mission Directorate (SMD), the Biological and Physical Sciences (BPS) Division having moved from into the Directorate in July. This is the first time since 1990s that all science work is in the same organization within NASA. The synergy will be excellent, as it is among the other SMD divisions. Dr. Craig Kundrot of BPS was to give a Division overview at this meeting. Dr. Hertz also noted a number of personnel changes within SMD and showed a chart of the SMD missions in space. These do not include the Neutron star Interior Composition Explorer (NICER), which is attached to the International Space Station (ISS), or the Stratospheric Observatory for Infrared Astronomy (SOFIA), which is not operated in space.

NASA launched its most recent Mars rover on July 30, in an effort to collect and cache samples for eventual collection and return to Earth. The next satellite to launch will be Sentinel-6 Michael Freilich, named after Dr. Freilich, who led NASA's Earth Science Division (ESD) for 13 years. Another noteworthy NASA science result was the Solar Orbiter images of nanoflares. The Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer (OSIRIS-REx) mission was about to touch the asteroid Bennu for sample collection and return, in a fully robotic activity. APAC would receive a presentation on the continuing progress with Webb, later in the day.

The Decadal Survey (DS) for astrophysics report is expected in spring of 2021; it will set priorities for the next 10 years. APD will be able to incorporate DS recommendations into the Fiscal Year 2023 (FY23) President's Budget Request (PBR). The biggest impacts will be from FY24 outward. APD is holding off on updating its implementation plan in anticipation of the new DS.

Budget/Covid-19 Impacts

Of APD's \$1.73 billion FY20 budget, 20 percent goes to community support, 12 percent to operating missions, 64 percent to mission development, and 4 percent to management. These ratios change over time depending on where the flagship missions are in the process, Explorer selections, and other factors. Dr. Hertz was not at liberty to discuss the FY21 budget; NASA is operating under a Continuing Resolution (CR) through December 11. There has been no change in the FY21 PBR, which the House is marking up and the Senate will address in time. APD received 25 Pioneers proposals, which it will subject to peer review for selection by the time the next APAC meeting takes place. The FY21 PBR proposes to terminate the SOFIA mission, which continues operating under the CR. It also zeroes out the Nancy Grace Roman Space Telescope (Roman), which continues development under the CR as approved at confirmation review. Dr. Hertz does not yet have a sense of how the Pioneers proposals break out, but he will report on it when the information is available. Dr. Hertz showed a sand chart matching the PBR, then showed what it might look like if Congress is consistent in continuing to fund SOFIA and Roman. If APD were to operate under a full year CR or the current House markup, the funding for Roman and SOFIA would be \$100 million higher than in FY20. This would essentially cut \$100 million from everything else. Should APD have to implement this, he will report to APAC on cuts, delays, and other choices.

Covid-19 has caused disruptions to all missions in development, and the assumption is that this situation will continue for quite a while. SMD is trying to mitigate what it can while maintaining portfolio health. All operational missions continue, but the balloon campaigns are cancelled throughout all of 2020. If possible, there will be a spring balloon campaign in New Zealand. Sounding rockets had been suspended but resumed last month with an astrophysics launch; another is pending. SOFIA flights were suspended for 5 months but resumed just prior to a scheduled maintenance period.

Research and Analysis (R&A) continues virtually, with some flexibility. There have been inefficiencies due to loss of facilities and working from home. There has been a loss of science, and NASA cannot assume it will be captured later. SMD has come up with some mitigations for Early Career (EC) researchers, which he would discuss later. Work-from-home issues and lack of lab access are not quantifiable, and NASA is not tracking it. The NASA centers are responsive to local metrics in their operations. There is a queue of balloon missions, and most investigators will have to wait a year because the work is seasonal. Dr. Meixner, Director SOFIA Science Operations Center, described the protocols for rescheduling SOFIA work, much of which will be completed, though there will be some reapplications required.

Dr. Laura Brenneman asked how budget cuts are decided when there is a shortfall. Dr. Hertz said that that is his responsibility. Every year, APD has to take the appropriation and develop an operations plan. The Division gets a top number and some specified items within that, then distributes the rest. They are already looking at how to realize \$100 million in savings if need be. The process is embargoed and happens quickly, but APAC can discuss priorities.

APAC Recommendations

APAC made a number of recommendations at the last meeting, and Dr. Hertz wanted to address each. Some of the recommendations would be responded to at this meeting via a discussion of the state of the profession, a presentation on Commercial Lunar Payload Services (CLPS), and an explanation of changes in the Exoplanet Research Program (XRP). At a future meeting, APD will discuss the archives Senior

Review (SR) and the SMD Data Initiative. Dr. Hertz explained that the Administration no longer requires foreign students to attend in-person classes during the pandemic in order to remain in the country. Two more recommendations are discussed in depth, below.

APAC had sought a detailed discussion of APD's process of decision-making and partnering. The Committee also wanted to know more about how U.S. scientists can join instrument teams, especially when those scientists are not from universities, NASA centers, and other organizations that have been heavily involved in NASA research. In response, Dr. Hertz presented and discussed the eight steps SMD takes in its decision-making process for providing NASA contributions to partner-led missions. There is also a draft policy document on the decision process. The acquisition strategy codifies who does the work. Where there are multiple options, SMD issues a Request For Proposals (RFP) or otherwise competes the project. Regarding U.S. PIs joining other teams, there is a process for that, which Dr. Hertz described. There is a regular U.S. PI call in Research Opportunities in Earth and Space Science (ROSES) to help investigators join the science team of any international mission for which NASA is not a partner. This is not an annual call, however.

Dr. Jessica Gaskin found this helpful. She asked about a scenario in which a potential foreign partner contacts a NASA Center rather than SMD in order to obtain a specific technology that could conceivably be competed. Dr. Hertz said that ideas can come from Centers, and SMD will determine whether to direct or compete such a project. Sometimes there are internal competitions, and there is an acquisition strategy for anything generic. SMD prefers open competition, but that is a waste where there is only one qualified proposer. For the U.S. PI call, the only rule is that NASA cannot already be involved.

There were additional recommendations and responses. As recommended, APD approved a new Exoplanet Program Analysis Group (ExoPAG) Study Analysis Group (SAG). APD announced that there would indeed be an Astrophysics Data Analysis Program (ADAP) call in both 2020 and 2021, reversing an earlier decision, on APAC's advice from the June 2020 meeting. A day of this meeting was to be devoted to Black, Indigenous, People of Color (BIPOC) participation issues, with an expanded mechanism for public input. APAC suggested that SOFIA develop strategies to achieve success during the next APD Senior Review (or equivalent), as the publication rate is low. Dr. Hertz reported that SOFIA has developed such strategies, which will be in the revised project plan. Another request was for a Webb status update, which was planned for this meeting. Regarding ADAP, Dr. Hertz noted that there were almost 350 proposals. In response to a question, he planned to see if there were more multiple submissions, noting that the Dual Anonymous Review Process (DARP) is going quite well and generating good feedback.

There were two recommendations about the European Space Agency's (ESA's) Athena mission. One concerned plans for the U.S. Athena data center; this is still being determined. The other advised the Athena Project Scientist to discuss with the Physics of the Cosmos PAG (PhysPAG) community the movement for a "one-stop shop" for X-ray data reduction for various missions. NASA welcomes PhysPAG input on this. Dr. Hertz would discuss further the flight-testing progress of super-pressure balloon designs identified for use with the Galactic/Extragalactic ULDB Spectroscopic Terahertz Observatory (GUSTO). APAC had also requested information about Contribution to ARIEL Spectroscopy of Exoplanets (CASE)/ Atmospheric Remote-sensing Infrared Exoplanet Large-survey (ARIEL) data products, which will occur at a future meeting. Finally, APAC asked for an update on identification of metrics and the efforts of the Science Activation Team (SciAct) to reach the broader community, including those without internet access. That was also to be discussed further.

Programs, Missions, and R&A

The balloon program had to pause due to Covid-19. Dr. Hertz explained that the current plan is to conduct one qualification flight of the super pressure balloon (SPB) from New Zealand in the spring. If that is not

possible, there will be a campaign in Sweden in the summer. Sweden is somewhat similar to the Antarctica launch environment as there is no sun setting on the balloon. The use of a zero-pressure balloon (ZPB) for GUSTO is being studied as a backup. Shipping time to the various sites can be a factor. Dr. Hertz described the SciAct metrics, which will be aligned with mid-level objectives per the National Academies of Sciences (NAS) assessment. SciAct funds two volunteer networks: Solar System Ambassadors (SSA) and Night Sky Network (NSN), the latter having held over 5,500 live events to date in 2020 despite the pandemic. SSA just surpassed 50,000 events since 2016. Since the June 2020 APAC meeting, nine new awardees have been selected for 5-year agreements.

Dr. Hertz presented APD science highlights, including the Transiting Exoplanet Survey Satellite (TESS) discovery of a hot Jupiter closely orbiting a white dwarf, which challenges prevailing theories. There have been a lot of R&A reviews, which Dr. Hertz listed. The reviews for ADAP and the Nuclear Spectroscopic Telescope Array (NuSTAR) Guest Investigator proposals have been conducted using the DAPR process. APD has been getting notifications on the results of proposal reviews out in less than 150 days from proposal submission dates.

The Division continues to provide funding to the community, and this will increase when Webb launches. Both R&A funding and proposals numbers have gone up while the selection rate has gone down. The overall budget has grown since the Roman work began, which affects the percentages. Dr. Woodward asked if there might be ways to stabilize the success rate. Dr. Hertz replied that there is no easy answer for that. Alternating years for the Astrophysics Theory Program (ATP) has been successful, and that approach could be appropriate for other program elements. DAPR improves the quality of peer review. The Planetary Science Division (PSD) has a two-step proposal process, which reduces the number of full proposals.

Dr. Leonidas Moustakas asked about the quality of proposals over time and whether PI grades go up with experience. Dr. Hertz said that that information is not available and he was not convinced the analysis would be valuable. There is no way to assure the standard is the same from year to year. The panels are supposed to grade on an absolute scale, but it is not clear how to measure that. The speed of notifications is a reflection of his strong team. A new R&A program element, Extreme Precision Velocity Foundation Science, was just released in response to a recommendation in the NAS Exoplanet Science Strategy and the joint NASA/National Science Foundation (NSF) Extreme Precision Radial Velocity (EPRV) Working Group. A graphic of the R&A program elements showed the increasing number evaluated using DAPR.

SMD is trying to mitigate Covid-19 impacts by offering grant extensions and other flexible mechanisms to EC researchers; the focus on EC is to ensure that future leaders in the field are able to continue. SMD Policy (SPD-36) states that the highest funding priority is support for graduate students and postdocs, followed by EC soft-money researchers. SMD will issue a ROSES call for funded extensions in the near future, to be funded from the R&A program at approximately 15 percent of the funding available for new awards in FY21. Payment of researcher salaries will be decided on a case-by-case basis. Dr. Bautista wondered if the success rate and Covid-19 impact affect large and small institutions differently. Dr. Hertz said that he could respond to that if APAC tells him the data they want.

The Hubble Space Telescope is still at peak productivity, and NASA is budgeting for it to continue operating. Its orbit is stable through 2030 at least. It has three gyros but can operate on one, and there is a plan to conserve them. The Space Telescope Science Institute (STScI) led the DAPR effort with Hubble and has received a NASA Honor Award for it. Hubble has observed some gravitational lensing that does not match predictions of dark matter in dwarf galaxies; this is still unresolved.

The Chandra mission, which has a new Director, had an anomaly in August with the High Resolution Camera (HRC). Science payloads were powered off during analysis, the Advanced CCD Imaging Spectrometer (ACIS) was powered back on September 11, and the mission resumed science observations the next day using ACIS only. ACIS accounts for 95 percent of Chandra observations. SOFIA had a science highlight about the Milky Way's central super-massive black hole. Dr. Woodward asked about the longevity projection for Hubble on one gyro. Dr. Hertz said that the mission has redundancy on a number of key components; he was not sure whether the gyros are most likely to be limiting. Until there is a failure, Hubble has a 5-10 year margin. Operating with a single gyro would result in more jitter and only half the sky at any given time.

While all SMD missions in development, formulation, and implementation are moving forward, they are experiencing disruptions due to Covid-19. The assumption is that these disruptions, plus reduced efficiency from work-at-home, will continue for the foreseeable future. SMD continues to look at short- and medium-term mitigation options, with an eye toward maintaining portfolio health. Specific options include use of reserves and delays of launch dates. Dr. Hertz then reviewed the specific Covid-19 impacts to astrophysics missions in development. Many launch delays and cost impacts may be covered within project and HQ-held reserves. The projects are constantly updating their risks, with independent assessments of their plans. If the biggest risk is in the supply chain, that will show up. Milestone reviews will call for either a replan or another outcome. Most milestone reviews occur according to the mission flow and may be delayed as mission development slows.

Artemis, UltraSat, and Roman

NASA's Artemis campaign will land the first woman and the next man on the Moon, and establish a continuing lunar presence. There are many opportunities to propose astrophysics research through use of Artemis capabilities. Ten papers proposed astrophysics research in the Payloads and Research Investigations on the Surface of the Moon (PRISM) solicitation, and two have been selected: the Low-frequency Radio Observations from the Near Side Lunar Surface instrument; and the Next Generation Lunar Retroreflectors. Artemis could also encompass smallsat and CubeSat investigations, and the DS panel was asked if APD should do anything via Artemis.

NASA is also joining the Israel Space Agency's UltraSat mission, which Dr. Hertz described. Science team membership will be competed via ROSES, and NASA will enable community-wide data analysis through the archives and ADAP and the Exoplanet Research Program (XRP). This is a strategic partnership. A NASA working group that previously worked on multi-messenger events recommended a UV transient survey capability, which UltraSat responds to. NASA has directed some money to the Goddard Space Flight Center (GSFC) to work on the next generation of transient alert systems. Israel approached NASA on UltraSat.

APD has formed the Roman Science Interest Group (RSIG) to provide community input to the Roman project. The first meeting was in early October. During the FY21 CR, NASA is continuing work as planned at the Phase C start. Some work has slowed but technology progress has been good. Dr. Hertz is not sure when there will be a return to full efficiency. Everything on Roman will be a function of the community input.

Decadal Survey Status

Dr. Hertz said that Large Mission Concept Studies were presented to the DS panels a year ago. There was a public meeting in August and current meetings are closed. The report is likely in the spring of 2021, and APD is now planning for implementation by looking at such items as risk reduction technology development, R&A recommendations, and Probe and flagship mission pre-formulation. APD is holding a \$50-100 million annual budget wedge for new initiatives.

Discussion

Dr. Woodward observed that the mitigation strategies for the Covid-19 impacts cannot go on indefinitely. Dr. Hertz said that he does not expect an existential crisis with the flagships or missions in development. Rather, the impacts will come in the future Announcements of Opportunity (AOs), and does not anticipate a delay. The hard one is Roman. APD does not see that growth has exceeded reserves, but it is complicated, and it is not in the PBR. Dr. Gaskin expressed concern about R&A instrument programs and how they have been affected. Dr. Hertz explained that APD has to invest for a balanced portfolio, and this includes low Technology Readiness Levels (TRLs).

Webb Telescope Update

Dr. Eric Smith provided the update on Webb. Work has continued through the pandemic, but social distancing requirements have caused some reduced efficiencies. The Launch Readiness Date (LRD) is now October 31, 2021, which is a shift of 7 months. The development budget is sufficient to get there. The team completed environmental tests at the observatory level and restarted the ground segment testing and operations rehearsals. The due date on the call for Cycle 1 General Observers (GOs) is now November 24, 2020. The simplified schedule shows that the schedule reserve is now measured in days. Science proposals are due soon, and there is a Launch Readiness Date (LRD) exercise planned for November. A chart showed the Integration and Testing (I&T) activities involved in space craft and sun shield deployments. The mission has numerous lower level reviews remaining and only a couple major ones.

Next, Dr. Smith provided an update on technical issues, some of which had been discussed with APAC previously. The Non-Explosive Actuator (NEA) for one sunshield Membrane Release Device (MRD) had failed during testing. This anomaly was localized during analysis. New NEAs are being manufactured and will be ready in time for installation during final observatory stow before shipping. There were also some MRD issues, and five new ones have been built. Three were installed on the observatory and went through environmental testing and two went through a series of offline tests. All MRDs (original or replacement) will have positive margins. The Deployable Radiator Shade Assembly (DRSA) had some redesign of slip joint interfaces; reassembly and qualification testing have begun. This will close out soon.

A fairing depressurization issue involved the trapping of residual air in the folded sunshield membrane continues to be worked. This has been analyzed by NASA and Northrup Grumman, and a path forward has been identified. The goal is to have all identified work completed by December 15. A new issue arose with the procedure to torque fasteners. The team looked at the records on over 12,000 fasteners and determined that about 160 fasteners will have to be retorqued. Some of these are grouped together, and the plan is to make the adjustments during the existing flow. He will get more detail during another review that Northrup has coming up. Dr. Mahadevan noted that there is only a single opportunity to get this right. Dr. Smith said that Webb cannot wait for data from the French Ariane flight and so will rely on models. Dr. Hickox asked if there might be any delays in shipping-to-launch portion of the schedule. Dr. Smith said that everything would be standard launch procedures once they get to Kourou. The team will have to install four actuators there, but the margin is good. Dr. Conklin was concerned about fasteners that might have been staked at the incorrect torque, and said that it seems unresolved. (The committee was later updated with information that none of the fasteners requiring retorquing had been staked.) Dr. Smith replied that the team will patch if the models are not found to be overly conservative.

He then described the proposal process, providing a link in the presentation for training. There are many tutorials and examples to help investigators prepare their proposals and obtain additional assistance.

Dr. Woodward asked about the frequency peak during launch to orbit, but Dr. Smith did not have that at hand. Dr. Mahadevan asked if the Cycle 2 proposals will offer opportunities for emergent astrophysics. Dr. Smith said that that will wait until after the first year of working with Webb. The early release science

program was instituted to get data to the community. Some data will become available immediately, and overall he expects the data to become available quickly.

Astrophysics CubeSat Missions Update

Dr. Michael Garcia discussed the astrophysics CubeSat effort. The first launch was HaloSat. Recent selections are:

- Black Hole Coded Aperture Telescope, BLACKCat, which will explore the transient sky;
- Supernova remnant, Proxies for Reionization, and Integrated Testbed Experiment (SPRITE), which will look at how galaxies provide ionizing radiation to the Inter-Galactic Medium (IGM); and
- BurstCube, which will study gamma ray bursts.

The Colorado Ultraviolet Transit Experiment (CUTE) is the next to launch. This CubeSat array will study the UV spectra of hot Jupiters during transit in order to measure the composition of the atmosphere being ablated away.

HaloSat Update

Dr. Phil Kaaret described HaloSat, the first satellite to be launched under APD's CubeSat initiative. The halo is the Circumgalactic Medium (CGM), and there are many questions about it. HaloSat will measure X-ray emissions from hot gas. Although small, HaloSat compares well with major missions and has been surveying the sky since October 2018. Dr. Kaaret described the measurements and modeling. HaloSat has shown that soft X-ray emissions from the CGM have large-scale variations. The CGM is also clumpy, which results from local variations in star formation. This is dominated by disk emission near the Galactic plane and should be an excellent tool to study feedback within the Milky Way.

Dr. Strolger suggested that the number of proposals and awards could make a case for having the CubeSat call every other year. Dr. Garcia explained that it is part of the APRA program, which comes out every year, but they will think about it. Dr. Garcia also mentioned that a second CubeSat could be funded in a given year via regular APRA funding if considered to be of sufficiently high priority. Dr. Mahadevan asked what one change in program management might maximize success. Dr. Kaaret said that the team proposed HaloSat with strong involvement of GSFC so that they could concentrate on science and instrument building. That is probably more effective than the way it is done now. He would like NASA to manage more on the spacecraft side, buying the busses and having PIs propose for them. Dr. Garcia added that the selection rate of one per year, for 4 to 5 years each, is what can be supported with the CubeSat budget line of \$5M annually. Operations are less expensive than the build. CubeSats are reviewed alongside sounding rockets and balloons.

Dr. Hertz returned with the answer to a question that Dr. Gaskin had asked him earlier. Two thirds of the Pioneers proposals were from academic institutions, 13 percent from NASA centers, and about 22 percent from other kinds of non-academic labs. As for multiple proposals on ADAP, they are the same as 2 years ago, with 93 percent of proposing PIs submitting one.

Biological and Physical Science Division Update

Dr. Craig Kundrot briefed APAC on BPS, which became part of SMD in July. Dr. Kundrot explained that BPS uses spaceflight environments such as the International Space Station (ISS) to study biological and physical systems, taking terrestrial systems into space in order to study them under extreme conditions like microgravity. The Division proactively seeks out new ways to expand fundamental scientific knowledge, and to provide expertise and support to others seeking to use space, while also investigating critical areas for scientific knowledge and technology development. Until recently, the Division operated out of NASA's Human Exploration and Operations Mission Directorate (HEOMD), so much of its work was oriented to human spaceflight. Now the team is looking at how BPS can relate to other parts of SMD.

BPS is currently guided by its 2011 DS and a 2017 mid-term assessment. The Division is making plans for its next DS.

The BPS Space Biology Program is very broad, covering plants, animals, and microbes down to the molecular level. The overarching objective is to learn how biological organisms respond to the spaceflight environment, then tease out the mechanisms of those responses. This promotes understanding of the impact of space travel and life on humans, and some of these discoveries apply to life on Earth as well. The Physical Sciences Program covers fundamental laws of physics and includes research that cannot be done on Earth. This Program emphasizes mechanistic understanding and helps develop cutting-edge technologies. There are many research platforms in addition to the ISS, and not all require actually going to space. Dr. Kundrot described a number of projects, like swabbing ISS surfaces for microbial samples to study the microbiome of the ISS and the astronauts; crew microbial inventory; long-distance plant defense signaling; Bose-Einstein condensate in orbit; and a burn rate emulator that has been used to discover things about the combustion process that we cannot otherwise measure.

Dr. Moustakas asked if BPS had found any cross-over areas with APD's recent gap survey of the community. Dr. Kundrot said that it was still early and the various units were having a lot of discussions. APD uses the universe as its testbed, and there are some areas of possible overlap, so while the experimental techniques might differ, there could be some coordination in areas such as dusty plasmas, dark matter, dark energy, and general relativity. Dr. Hickox asked about use of the Cold Atoms Lab (CAL) and any plans for comparable facilities. Dr. Kundrot said that on CAL, NASA is working with the Germans, who will take it further.

Balloon Roadmap Update

Dr. Peter Gorham, chair of the Balloon Program Analysis Group (PAG) noted that APAC should have received the roadmap report. He reviewed the PAG's charge and process. The report was delayed because of Covid-19. Balloons are important in astronomy because they provide a unique platform for groundbreaking science and a test bed for future space-flight instruments, while also offering a hands-on training ground for EC researchers. APD manages the balloon program for all of SMD. Dr. Gorham gave some examples of balloon research. At this point, there is no centralized repository for this research, most of which is managed out of universities. He took an informal recommendation to look at this further.

The report had four categories of findings and recommendations: balloon capabilities; launch sites and facilities; funding opportunities; workforce development, education, and outreach. SPBs are the first priority under balloon capabilities, followed by payload telemetry, lift capabilities, pointing systems, large aperture telescopes, opportunities for small payloads, and aerostats as commercial opportunities. The launch sites and facilities area encompass the various sites, infrastructure investment, crews, and mission safety protocols. In the area of funding opportunities, the PAG was pleased to see that APD's new Pioneers mission class will include balloons, as this class of investigation is particularly important for long-duration and ultra-long duration payloads that launch from Antarctica, Sweden, and New Zealand. The PAG would like to see this program remain a part of APRA. Another positive element is the inclusion of balloon payloads in Explorer Missions of Opportunity (MoOs). Finally, workforce development is a significant area, encompassing diversity, EC opportunities, and more.

In answer to a question, Dr. Gorham said that the LDB program has always been done right and has offered incredible training for students who have gone on to do well in the field. The hardest thing is balancing safety, which has to be addressed continually. There was also discussion of how balloon missions are evolving, such as in the direction of larger telescopes that allow pointed observations of targets. That would allow much of the program to be GOs combined with larger missions. Balloon missions are already getting longer. Aerostat came up as a dedicated observation. Dr. Gorham believed that the concept of larger apertures was presented to the DS.

Astrophysics Sounding Rocket Missions Update

Dr. Galeazzi recused himself due to a CoI. Dr. Thomas Hams discussed the sounding rocket program which, like the balloon program, matures technologies while growing the future workforce. It is also important in risk mitigation. The Heliophysics Division (HPD) manages the Sounding Rockets Program Office (SRPO) for all of NASA. Dr. Hams showed the launch sites of interest for astrophysics, noting that there are additional locations. Covid-19 has presented some challenges, but SRPO was able to resume operations after presenting a plan to management. The Program has since launched an Astrophysics mission. PIs are asked to highlight science, training of the workforce, and technology.

The Determining Unknown yet Significant Traits (DUST) mission is a laboratory astrophysics investigation studying dust grain formation. The sounding rocket flight provides the microgravity study environment for this sample return mission. Dr. Hams showed the DUST objectives and payload, and discussed the instruments and analysis. SRPO will be focused on launches from Australia that will start in January, if Covid-19 issues allow, and there are plans to start launching next summer.

Dr. Gaskin observed that the manifest included only a few individual PIs from a handful of institutions. She wondered how hard it is to break in, given this level of experience, and she asked what this says about the number of sounding rocket proposals. Dr. Hams said that his back-up slides had information about the next generation being enabled by the senior investigators. Some PIs do not see this as a vehicle for pursuing their science. One factor in participation is being acquainted with the program. Dr. Gaskin noted that DUST seemed driven by an international contribution, and she wondered about accessibility. Dr. Hams said that SRPO is trying to offer opportunities to lower the barrier. A PI needs to build a team, and that might be something to discuss.

PhysPAG Update

Dr. Graca Rocha presented the update on PhysPAG, which has six Science Interest Groups (SIGs). The Executive Committee holds monthly telecons. In response to APAC recommendations, the PhysPAG, COPAG, and ExoPAG chairs had a virtual coordination meeting in September. They converged on three cross-PAG activities:

1. Cross-cutting technology;
2. Data analysis frameworks and transferability; and
3. NASA science at under-resourced institutions.

In addressing the first activity, the PAGs plan on holding a joint technology session at the January American Astronomical Society (AAS) meeting. Dr. Rocha described the plans for the session, which will address synergies in technology development across APD. For the second activity, the PAG chairs agreed that they would prefer to create a new, joint SAG on data analysis frameworks, with the goal of assessing the need for implementation as an integral part of technology development. This effort will need to ensure that it is in the context of the ongoing NASA Data Science effort. The Chairs are interested in knowing if there is a specific analysis the PAGs could do that would be useful to NASA. Regarding under-served groups, the PAGs have convened a joint initiative that includes Executive Committee members to address issues of equity and inclusion in NASA astrophysics research. There have been two telecons thus far, with plans for more. This cross-PAG initiative aims to analyze barriers to participation, via activities such as a survey of the community. The expectation is that this will lead to creation of a SAG on the topic.

All of the SIGs will have splinter sessions at the winter AAS meeting, and all but one will have splinter sessions at the American Physical Society (APS) meeting in April. Dr. Woodward asked for more on the demographics initiative, given that both NASA and NAS are looking at this. Dr. Rocha replied that the PAG chairs want data, and wish to survey the community at large and assess the impact of current

program. Dr. Strolger was concerned about possible redundancy. Dr. Hickox said that the AAS special session would be parallel to the potential SAG.

Public Comment Period

For this meeting, the questions from the public came via chat or a portal. There was a question about the cancellation of the European Space Agency's (ESA's) Space Infrared Telescope for Cosmology and Astrophysics (SPICA) mission and the implications for new opportunities for NASA mission concepts. Dr. Hertz replied that this will be assessed after the DS comes out, as it will set research priorities in astrophysics, and APD will respond to those priorities. Another question was about the Webb presentation and how conservative the models are; Dr. Smith was not available at the moment and so APAC would ask him to respond later. A question directed at Dr. Hertz concerned the out-year budget for Pioneers and the intermediate implications. Dr. Hertz said that the chart in question had a line for Probes, not Pioneers, and that funding is held but not yet programmed. It is available for DS priorities. Dr. Moustakas read a comment from the chat on the topic of sounding rockets and diversity. Most of this research involves UV or X-ray astronomy, and it can take 2 or 3 years to construct the payloads, requiring considerable skill and investment on the part of the PI. The programs are geared toward enabling new science and new technologies. Lessons learned are passed along via oral tradition, and other institutions therefore do not have the base to mount competitive missions.

Dr. Moustakas read a question for Dr. Hertz from Dr. Gorham, on what appeared to be decreased funding and time for postdocs, which seems like the wrong direction. Dr. Hertz explained that the budget wedge being referred to is the Hubble postdoctoral fellowships. This is not all of the postdocs that APD supports; a huge number are supported through the R&A program. Several years ago, he had asked this Committee to examine the size of the Hubble fellowship program and whether any of that money should be reallocated. That is what happened after extensive discussion by APAC. All of the reallocated funds went into the R&A program.

Discussion

Dr. Conklin said that the HaloSat discussion inspired a comment, that it had been suggested that NASA might procure the bus to reduce the cost. However, the buses seem to all come from the same place. Dr. Woodward cited some different technologies. Dr. Hertz said that the program strives to make any changes necessary to be cost neutral.

Dr. Woodward asked if telemetry needs might be an area for leverage of technology. Dr. Hertz said that there is a lot of discussion on communications systems, especially looking out to the future with large data volumes. A briefing would be possible on request. Dr. Woodward then noted that there seems to be a lot of commercial off-the-shelf development for CubeSats and balloons. He asked if APD is gathering the best ideas and implementations for future builds. Dr. Hertz said that this is occurring SMD-wide for CubeSats. For balloons, PIs can get lessons learned from the program office. It is not as formalized as for CubeSats and smallsats.

Regarding the ATP and DAPR, Dr. Strolger observed that the goal of DAPR is to not obfuscate the identity of the proposer but instead to discuss the science being proposed rather than who is doing it. The proposal should talk more about the science and less about the people involved. Dr. Woodward thought this lent itself to a recommendation. Dr. Hickox asked if there might be any relevant experience on archival programs. Dr. Strolger said that there is some, but the point is not to scrub identities, it is to focus conversation on the science. Dr. Hertz added that the initial reports are that the peer reviewers are finding this system to work. Only 1 out of 300+ proposals was noncompliant.

Dr. Woodward said it would be good to get something quantitative on the impact Covid-19 has had on different types and levels of institutions. Dr. Hertz noted that other organizations might be looking at this

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more broadly. Dr. Woodward also said that it appears the capabilities and duration of balloons could lead into the realm of observatories. Dr. Bautista asked what funding is needed to fly above 160,000 feet, in the UV band where there are fewer instruments. Dr. Gaskin explained that this project involves an older balloon that has been redeveloped. The team is talking about it taking 10 years. The interim developments will find people to take advantage of them. It will be interesting to see if BPS can get involved in this.

Wrap up for Day 1

Dr. Woodward said that the next day would involve a brisk discussion of the GPRAMA material. He closed the meeting for the day at 5:05 p.m.

Tuesday, October 20

Opening Remarks

Dr. Hasan opened the meeting, reminding APAC members of the COI and recusal requirements.

Dr. Woodward said that APAC had sent two requests to Dr. Smith about Webb and received one response thus far. The question was whether fasteners that needed to be torqued had been staked. The answer was that none had been staked.

Artemis CLPS/Astrophysics Payloads Update

Dr. David Burns, Acting Deputy Associate Administrator for Exploration, introduced himself and Dr. Brad Bailey of SMD. The Exploration Science Strategy and Integration Office (ESSIO) formulates and executes an integrated strategy for exploration science. This goes beyond SMD to include payloads from HEOMD and the Space Technology Mission Directorate (STMD). The Lunar Discovery and Exploration Program (LDEP) is charged with much of the implementation strategy, which Dr. Burns described. The program does not buy landers or vehicles, but it does buy the payloads.

The goal of CLPS is to use commercial delivery services in accessing the Moon. To do that, NASA uses task orders for 14 companies that bid on the projects. There are currently two of these task orders per year. One of the purposes is to help companies make investments on the Moon. Thus far, there have been five lunar surface delivery orders awarded, and the first two are scheduled to launch in 2021. NASA is moving to consolidate acquisition under PRISM, which will have annual calls offering two opportunities to deliver payloads to the Moon. There were 238 responses to the first Request for Information (RFI). Dr. Bailey showed a chart with the delivery sites and cadence through 2024, and described each payload. Over time, LDEP has been moving toward PI-led investigations of science questions. Dr. Burns noted that the fixed price task orders do not require the same level of review as other mechanisms. These task orders specify the instruments and interfaces. NASA then has a payload integration meeting with the awardee. The Task Order 2 (TO2) payloads include the Volatiles Investigating Polar Exploration Rover (VIPER), which is an order of magnitude increase in complexity.

Dr. Bailey said that the program determined the science objectives enabled by lunar exploration. He described opportunities for training, resources, and enabling science. Among the six science objectives is studying the universe, which encompasses astrophysics. Two instruments with astrophysics implications are ROLSES (Low-frequency Radio Observations from the Near Side Lunar Surface) out of GSFC, which will launch in 2021, and the Lunar Surface Electromagnetics Experiment (LuSEE), which will be on a far side delivery. There is also a next generation reflectors project in the works.

CLPS delivery manifests are selected through the CLPS Manifest Selection Board (CMSB), which includes representatives from across NASA. Dr. Bailey described the selection process, noting that

international contributions can comprise up to 30 percent of a mission. CLPS will allocate and manage delivery of science payloads as part of the overall Artemis campaign. The science definition team (SDT) just released its report. The Office is focused on developing instruments, defining science, and integration into Artemis.

Dr. Moustakas expressed concern about abrasion and other environmental issues that could affect astrophysics payloads. Dr. Burns agreed that lunar regolith could be problematic and preclude operations of large mirrors, though it would have much less effect on radial velocity astronomy. Dr. Bailey described how ESSIO is studying the ways in which regolith interacts with and affects various materials. Dr. Woodward said that much of astrophysics requires clean environments, and there will be a lot of activity in the lunar environment. He asked about clutter and debris management efforts. Dr. Burns said that ESSIO is working on this and is concerned with planetary protection and heritage sites. Nobody wants to contaminate pristine sites. The legislative guidance is lagging here, and while NASA has principles and practices, the international and commercial sides do not share a common set of guidelines. In answer to another question, Dr. Bailey said that there is not yet a mapping effort planned for gravitational waves, but they want to do campaign science, comprising data sets of continuing measurements.

TESS Update

Dr. Patricia Boyd explained that TESS is a NASA Astrophysics Explorer mission led and operated by MIT and managed by GSFC. It is now in extended mission, going into Sector 31, with 348 publications submitted, 285 peer-reviewed (51 percent exoplanets, 49 percent astrophysics). TESS is small, about the size of a washing machine. There are two main types of data selected at any time. TESS goes the next step beyond Kepler, looking at what can be followed up. Covid-19 hit when TESS was in sector 22. While mostly working from home, the mission team has since done nine sectors and it is going smoothly. There are many virtual meetings. Meanwhile, TESS provides a lot of data and is making great progress.

Dr. Boyd discussed high-level science results, noting she had references on her slides for those wanting more detail. TESS was launched to find small planets near bright stars. Three EC researchers found TESS's first Earth-sized exoplanet in the habitable zone. The team is evaluating whether this might be a good fit for JWST follow-up. She showed the hot Neptune desert and a new planet discovered on the edge. TESS also does full-frame images. Some of the stellar astrophysics coming out of TESS includes low-frequency gravity waves (not gravitational) in blue supergiants, and the discovery and early evolution of ASASSN-19bt, the first Tidal Destruction Event (TDE) detected by TESS. Data are first processed at NASA's Ames Research Center (ARC) and at MIT. A steering committee looks at threshold-crossing events and sorts out the false positives for real targets. The team for telescope observing, which is international, has to move quickly. After each sector's data are processed, a steering committee sorts objects into prioritized groups.

Dr. Boyd presented a chart showing the data cadences in extended mission. These include a new "fast" 20-second cadence, and full frame image cadence of 10-minutes (as opposed to 30 minutes in the prime mission). The overall goal is to obtain more data, revisiting some targets and filling in gaps in the original survey. This includes over 2,200 small planet candidates, plus planets in habitable zones and planets with periods longer than 20 days. She showed where third-year data will land and noted plans for Cycle 4, which will be 15 months. TESS has been delivering data ahead of schedule, and all data are immediately public with multiple means of access. Download numbers from the Mikulski Archive for Space Telescopes (MAST) archive show that TESS data are extremely popular, and publications are increasing. A total of \$3M in grant funding from the mission was awarded to successful guest investigator proposals for Cycle 3. The Planetary Science Division (PSD) awarded some additional funding for a highly selected solar system investigation.

Dr. Meixner asked if the hot Neptune might be a Webb target. Dr. Boyd said that many groups are actively prioritizing TESS targets for JWST, and she would have to find this specific one. Dr. Conklin asked about any anomalies or downlink issues. Dr. Boyd replied that TESS went into safe mode once early on, with a quick correction. It is in good shape now despite occasional spacecraft jitter. There have been a few blips with the Deep Space Network (DSN), but TESS has collected all the science data for the 26 sectors and will make additional passes.

Swift Update

Dr. Brad Cenko explained that the Neil Gehrels Swift Observatory (Swift) launched in 2004 with three instruments and can see one sixth of the sky at any given time. It moves swiftly as needed, hence the name. In recent times, the priorities have shifted, from primarily gamma-ray bursts to Guest Investigator and Targets of Opportunity. The primary science goals are the dawn of multi-messenger astronomy and the time-domain revolution. Dr. Cenko listed some results from the last year. Swift has shown that even observatories that have been operating in space for a long time can have new and improved capabilities enabling novel science, including Gamma-ray Urgent Archiver for Novel Opportunities (GUANO). Tools that produce automated, publication-quality data products are invaluable, allowing non-experts to use the data and expanding the user base. The Guest Investigator programs are very important, and have had a significant impact on both the science and the way Swift operates. The mission will have its first DAPR soon. The Swift team is also working to improve ways of handling community interest via automatic means. This does not involve building anything new, but the team is trying to define a protocol to make use of brokers to trigger rapid and easy request submission and scheduling. To that end, they are seeking community input on what constitutes the most compelling science.

Exoplanet Research Program

Dr. Pamela Marcum, APD XRP Program Officer, explained that the Program is cross-divisional and listed the other representatives from SMD. On March 20, XRP responded to the Covid-19 situation by allowing Notices of Intent (NOIs) in lieu of Step-1 proposals. Regardless of which direction proposers took, Step 2 proposals were due at the end of May. Peer review has been conducted virtually, and award letters are going out. XRP focuses on the advancement of exoplanet science; Dr. Marcum gave some examples. The solicitation, which encouraged cross-disciplinary investments, is very specific in order to distinguish it from other programs. Dr. Marcum noted the types of work considered out of scope and explained where those investigations should go instead. There have been changes from past XRP solicitations. XRP now supports exoplanet research elements that had previously been proposed to ADAP, ATP, and the Lab Astro component of APRA. In addition, there is a requirement for a Data Management Plan (DMP) to be included within the 15-page limits of the Science/Technical justification section of a proposal.

The profile of selected proposals shows a selection rate that has been mostly flat or decreased. However, the collaboration of the SMD divisions has resulted in a substantially larger budget. The proposal review process is managed collaboratively by the divisions. Selections are not tied to specific divisions. Dr. Marcum described some recently funded investigations. As the budget goes up, selection rate will go up; the increased budget will likely also encourage more proposal submissions over time.

Dr. Meyer asked if there might be a selection rate increase due to expectations of the combined programs. Dr. Hertz replied that the funding that was moved matched the proposal submissions, but that previous to this year, people had been submitting to multiple programs. With the consolidation and explicit distinctions between the research coverage of XRP relative to other programs, the submission of a proposal to XRP and other programs will be rare. Dr. Moustakas asked how the coordinated panel is going. Dr. Marcum reported that the process went smoothly and program officers from all 4 SMD

Divisions worked well together during both the peer reviews and the proposal selection process. Following the primary goal of the multi-divisional collaboration, the proposals with the highest science merit were selected regardless of divisional boundaries. Dr. Mahadevan expressed concern that the budget profile just reflects money moved around without an increase in funding for exoplanet science. APAC had previously thought the selection percentages might be too low. Dr. Hertz said that there was no money added for exoplanet research, but the funding was consolidated. Reallocating some funding originally in, for example, the ADAP budget to XRP does increase funding for exoplanet science; those exoplanet-relevant investigations no longer have to compete against all the other astrophysics topical areas for funding. This consolidation allows SMD to fund the best exoplanet research, but the Directorate does not have a demand-driven budget. Rather, the goal is a balanced program. XRP is a good fraction of the R&A program.

COPAG/ExoPAG Updates

COPAG

Dr. Meixner began by stating her own commitment to enabling a more diverse and inclusive workforce. She wants change and feels a responsibility to help move herself, her team, and NASA forward to an equitable environment. She wants to see results, with less focus on the process. She also wants to be held accountable to making change.

The Cosmic Origins Community commits to an environment of inclusion where all voices are welcomed and heard. To that end, COPAG is taking every opportunity to implement actions to be more inclusive and engage diverse voices throughout the astrophysics community. The bi-weekly meetings include two regular agenda items to discuss inclusion, diversity, equity, and accessibility. The PAG is also seeking to have a more inclusive and diverse Executive Committee, and will do the same with SAG and SIG membership. There is a community outreach plan, and there are ongoing discussions of other possible analysis actions. COPAG tries to have 12 to 16 members on the Executive Committee in order to reflect the breadth and depth of cosmic origins research. Dr. Meixner described how members are recruited and appointed, which involves APD. However, for the next round of appointments, there is not sufficient diversity across the necessary axes. Therefore, COPAG has decided to not make appointments until there is a slate of candidates that meets the criteria. The PAG is redoubling efforts to recruit more broadly over the next month but could use help from APAC and others in finding potential members.

Dr. Meixner then reported on COPAG activities since the last APAC meeting. The Executive Committee is discussing new SIGs, such as Beyond Cosmic Dawn and the Galaxy Ecosystem. A new SAG is proposed to evaluate the potential of DS flagship and probe recommendations. There are new members on the InfraRed (IR) SIG. COPAG has been looking at ways to improve its online presence, including a new website, an expanded and simpler email list, and a tele-seminar platform. Work with APD's new Cosmic Origins Chief Scientist continues, as does outreach to EC IR scientists. COPAG is also organizing a session for the AAS meeting. There is a lot of concern about the long-term outlook for IR astrophysics, given the SPICA decision, and COPAG is committed to advocating for IR science. The Cosmic Dawn SAG, which is being done in conjunction with PhysPAG, has been delayed by Covid-19 and the fact that members are overwhelmed with online teaching and life working from home. A possible new SIG would focus on the Galaxy Ecosystem/Gas Flows, and reflects the community's strong interest in CGM science. Another new group, either a SIG or a Technology Interest Group (TIG), would focus on long wavelength radio astronomy. Again, there is strong community interest in this topic.

Dr. Meixner listed the planned sessions for AAS and reiterated the request that APAC help in recruiting executive committee members consistent with inclusion.

Dr. Conklin asked if the plan is to have the UV and IR SIGs morph into something else not related to wavelength. Dr. Meixner replied that COPAG is looking at that. While the PAG will not disband anything that is working, there is a goal of growing scientifically to a wider community.

ExoPAG

Dr. Meyer provided an update on ExoPAG. There is an effort to solicit new Executive Committee members, which can be difficult given that there is no compensation. Since APAC's last meeting, ExoPAG has focused on institutional racism and is working with the other PAGs on this. The PAG made a presentation to the Planetary Science Advisory Committee (PSAC) and participated in a Nexus for Exoplanet Systems Science (NExSS) roundtable. The review of the science gap list is now complete, and the PAG hopes to have a fall community forum to prepare business for the virtual ExoPAG 23 to be held in January.

Dr. Meyer described the Exoplanet Explorers Program, a pilot Speaker Series program for early career scientists that has a solicitation out. Along with the informational and interactive aspects, there will be some stipends. SIG 2, on Exoplanet Demographics, is having monthly telecons and will participate in a NExSci workshop in November. SIG 3, ExoSS Goals, Progress, Plans, evolved from a previous ExoPAG finding and will continue organizing webinars and exploring opportunities for research between the exoplanet and solar system communities. SAGs 21 (Effect of Stellar Contamination on Space-based Transmission Spectroscopy) and 22 (Exoplanet Host Properties) were discussed at the last APAC meeting and are moving forward with telecons and working groups.

Future activities include the close-out of SAG 19 (Exoplanet Imaging Signal Detection), possible new SAGs on zodiacal dust and high contrast imaging, continued monthly telecons, ExoPAG 23 held before the January AAS sessions, a possible cross-PAG SAG on the lack of equity in astrophysics science, DS analyses, and participation in PSAC and NExSS discussions.

Dr. Bautista cited Dr. Meixner's call for diversity, and noted that Dr. Meyer referred to cultural taxation, where members of under-represented groups receive sometimes unmanageable numbers of requests to represent their groups without compensation. Dr. Meyer said that there is no easy solution to this, which is one reason ExoPAG wants to include a stipend for ExoExplorers. He will report back on its success.

Public Comment Period

It was decided that the questions submitted to the portal for public comment would be most appropriate for the third day of the meeting and its broader discussion.

ISFM Update

Dr. Daniel Evans provided an update on NASA's Internal Scientist Funding Model (ISFM), which was launched as a result of a 2015 internal study that found that NASA was spending significant resources competing for research funds that were already appropriated. That system placed EC scientists at a disadvantage while forcing Civil Servant (CS) scientists to write many proposals in order to cover only a small fraction of their time. One of the results was a lack of strategic hiring of scientists at NASA centers and a dearth of NASA-wide planning. ISFM is meant to address these deficits with work that is strategic, enabling of science, forward leaning, and distinctive.


















APD focuses its ISFM investments to take advantage of the Centers' unique capabilities, their CS and contractor personnel, and overall NASA, SMD, and Division goals. Because this work is directed only where APD has determined that competitions would bring in no other players, relatively little work has been directed. Dr. Evans showed the 10 projects selected thus far. About one third of the research dollars NASA sends to the centers are now through ISFM, and this ratio is the same as it was from the prior competitions. At the same time, APD is waiting for the DS before moving into the next round.

Dr. Mahadevan asked about collaborations. Dr. Evans replied that APD is in constant dialogue with colleagues about expanding ISFM, and expects the DS to point in that direction. Dr. Gaskin noted that a lot of the technologies developed are multi-disciplinary and have other applications as well. Dr. Hickox asked if the center science programs have become more strategic. Dr. Evans said that there is more that could be funded, but this is a balance that allows centers to provide input on what they consider strategic. He added that it would be difficult and disruptive for ISFM grantees to apply for similar work through competition. They can request modest increases if needed.

GPRAMA Process Overview

Dr. Michael New, NASA SMD Deputy Associate Administrator for Research, explained that every year, SMD identifies its science performance goals via GPRAMA. Since SMD is encouraging more inter-divisional work, the GPRAMA reviews will now reflect that. More specifically, for each of the nine science goals, one division will lead the review and designated divisions will provide input. The SMD science performance goals with primary and secondary review responsibilities are in Table 1, below.

Table 1

PERFORMANCE GOALS	APAC	ESAC	HPAC	PAC
1.1.1 NASA shall demonstrate progress in exploring and advancing understanding of the physical processes and connections of the Sun, space, and planetary environments throughout the Solar System.				
1.1.2 NASA shall demonstrate progress in exploring and probing the origin, evolution, and destiny of the galaxies, stars, and planets that make up the Universe.				
1.1.3 NASA shall demonstrate progress in exploring, observing, and understanding objects in the Solar System in order to understand how they formed, operate, interact, and evolve.				
1.1.4 NASA shall demonstrate progress in discovering and studying planets around other stars.				
1.1.5 NASA shall demonstrate progress in improving understanding of the origin and evolution of life on Earth to guide the search for life elsewhere, exploring and finding locations where life could have existed or could exist today, and exploring whether planets around other stars could harbor life.				
1.1.6 NASA shall demonstrate progress in developing the capability to detect and knowledge to predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.				
1.1.7 NASA shall demonstrate progress in identifying, characterizing, and predicting objects in the Solar System that pose threats to Earth or offer resources for human exploration.				
1.1.8 NASA shall demonstrate progress in characterizing the behavior of the Earth system, including its various components and the naturally-occurring and human-induced forcings that act upon it.				

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| 1.1.9 | NASA shall demonstrate progress in enhancing understanding of the interacting processes that control the behavior of the Earth system, and in utilizing the enhanced knowledge to improve predictive capability. | | | | | | | | |
|-------|--|--|--|--|--|--|--|--|--|



Green = lead. Yellow = secondary.

Ms. Jennifer Kearns of SMD provided background on GPRAMA, which requires each Federal entity to provide a strategic plan, an annual performance plan, and an annual performance report to evaluate progress made in key areas. In SMD, the performance measures address milestones for missions and development. There are also measures of science progress, the nine performance goals discussed by Dr. New, which call for review by external experts. In the case of astrophysics, APAC conducts that review, which is a very high-level assessment based on achievements during the past year. The goal is to obtain a rating and provide some supporting material. Ms. Kearns noted that APAC should stay with the wording of the performance goals as presented.

Any accomplishments cited in the supporting material should represent growth, and APAC should also note any disappointments. The time period under consideration does not follow the fiscal year precisely, but rather covers the time since the previous review, which in this case would go back to APAC's meeting of August, 2019. The accomplishments considered must result in whole or in part from a NASA-funded activity, but that funding did not need to come from APD specifically. Dr. Hasan had sent the members a document with items that they could consider, though they were not restricted to using those examples. The only requirement was that the APAC material be sufficient to back the conclusions.

Key to the GPRAMA evaluations are the color ratings, which have not changed since last year:

- GREEN: Expectations for the research program fully met or exceeded in the context of resources invested.
- YELLOW: Some notable or significant shortfalls in context of resources invested, but some worthy scientific advancements achieved.
- RED: Major disappointments or shortfalls in the context of resources invested, uncompensated by other unusually positive results.

Ratings other than Green needed to have a clear rationale in the text. A NASA team will synthesize APAC's examples for the final report.

GPRAMA Discussion

Dr. Hasan introduced Dr. Michael Liemohn from HPAC and Drs. Amy Mainzer and Serina Diniega from PAC. Dr. Woodward opened discussion of Performance Goal 1.1.2: "NASA shall demonstrate progress in exploring and probing the origin, evolution, and destiny of the galaxies, stars, and planets that make up the Universe." Dr. Hasan's document included the following suggestions for examples:

1. How to Shape a Spiral Galaxy
2. Black Hole Nurtures Baby Stars a Million Light-Years Away
3. Chandra Spots a Mega-Cluster of Galaxies in the Making

Dr. Hickox pointed out that these were all extragalactic, and there were other interesting discoveries. Dr. Strolger suggested including an HUBBLE observation of Betelgeuse; others agreed, and Dr. Woodward pointed out that there were SOFIA observations of Betelgeuse as well, which could go into an example combining the two missions. Drs. Moustakas and Meixner advised the APAC members to consider balance. It was agreed that #2 was compelling; the Committee set aside #3 for the moment.

The discussion of the Planetary examples led to consideration of two:

- Streaming Instability in Turbulent Protoplanetary Disks
- The Little Dippers: Transits of Star-Grazing Exocomets?

Of the Heliophysics examples, all of APAC liked the Voyager example, and it was agreed that they wanted to include a sounding rocket example as well:

- Voyager 2 Enters the Interstellar Medium
- Coordinated Hinode and Sounding Rocket Observations Challenge Coronal Heating Theories

In answer to a question, Ms. Kearns said that she did not yet know what the length of the report would be, but it would be condensed from whatever APAC provided. Dr. Hasan suggested that APAC rank the examples and include a sentence on why each is important.

In discussion of the white dwarf/hot Jupiter result, some APAC members thought it should be under Multiyear Performance Goal: 1.1.4: “NASA shall demonstrate progress in discovering and studying planets around other stars.” For that Performance Goal, APAC preferred the following three items:

1. NASA’s Hubble Finds Water Vapor on Habitable-Zone Exoplanet for First Time
2. Confirmation of Toasty TESS Planet Leads to Surprising Find of Promising World
3. NASA’s TESS, Spitzer Missions Discover a World Orbiting a Unique Young Star

After further discussion, it was agreed to include the white dwarf/hot Jupiter example and see which other results could be paired.

There were five Planetary candidates, with the finalists being:

- Impact of Clouds and Hazes on Simulated JWST Transmission Spectra of Habitable Zone Planets in the TRAPPIST-1 System
- Sensitivity Analyses of Exoplanet Occurrence Rates from Kepler and Gaia
- Characterization of Low-mass K2 Planet Hosts Using Near-infrared Spectroscopy

For Heliophysics, APAC chose:

- Modeling a Stellar Superflare and Coronal Mass Ejection

Dr. Gaskin asked if they might also make a statement about Covid-19. Dr. Woodward suggested that it say that while science has been lost due to Covid-19, NASA has made progress. Ms. Kearns said that there will be discussion of Covid-19 in the report; when Dr. Woodward said that APAC still wanted to make a short statement, Ms. Kearns assured him that SMD would make a point to retain that the text in the report. Dr. Moustakas was concerned about the nuances, since they still want to get back to full efficiency. Dr. Kelly Holley-Bockelmann agreed, but thought it was important to point out that they are reaping the benefits of a rich and varied program. Dr. Moustakas thought they might say they anticipate Covid-19 impacts next year.

Dr. Woodward called for a vote on 1.1.2. A voice vote was unanimous for Green with no abstentions or objections.

He then called for a vote on 1.1.4. A voice vote was unanimous for Green with no abstentions or objections.

Drs. Liemohn, Mainzer, and Diniega all voted Green on both Performance Goals.

Dr. Woodward said that he would send out an email with the writing assignments, to be returned by COB on the 30th, ideally with graphics. He would synthesize and set APAC preferences in case there is editing.

Discussion

Dr. Mahadevan said that it appears that Lab Astrophysics is moving to XRP, which is positive. He wanted more clarity on where to apply for technology development, noting that low TRLs needs support. Dr. Hasan said that that is in the supporting technologies part of APRA. Dr. Bautista asked about reasonable success rates. Dr. Strolger added that there is a fine line between being competitive and discouraging proposers at the onset. Dr. Bautista said that it is hard to get tenure without a funded project, but full professors can find it painful to keep writing proposals. The community has been hurt by low success rates. Dr. Gaskin noted that this will vary by opportunity. No one is getting the funding they want. It is an ever changing environment and hard to predict. Dr. Meyer pointed out that exoplanet research as a field is growing rapidly. APAC cannot propose a success rate, but they can propose rebalancing priorities. Dr. Strolger countered that it takes 2 years for these changes to go through, during which time the field will change further. Dr. Holley-Bockelmann reminded the Committee that there was about to be a new DS and possibly a new administration, so the timing of a recommendation could be premature. Dr. Woodward thought they could suggest that program rebalancing may be required following the DS. He asked the members to think about how to phrase their success rate concerns.

He said that the CLPS Artemis discussion was good, and APAC will want them back. The TESS archive and community use of data might be a best practice model. The synergy among TESS, Swift, Fermi, and NuSTAR demonstrates a good capability of Division assets. He liked Dr. Meixner's comments on full utilization of the workforce and maintaining diversity especially with groups that have not been served well. He noted that when releasing pictures of teams, people need to be aware of the message they project; pictures should reflect the diversity and environment they want to create.

Dr. Smith returned an answer about the JWST fairing depressurization threshold, which Dr. Woodward read. Northrup tests of sunshield membrane material for strength have generated data used in modeling of the as-built sunshield. The areas of concern for depressurization involve assemblies of the membrane materials and MRDs. These assemblies are located where models of depressurization indicate the values may see strength margins. Northrup has not reproduced to-scale models of the MRDs and the surrounding membrane material to test this phenomenon. The number of locations where this concern exists is small, and it is more cost-effective to rely on the modeling and/or simply reinforce the membrane material in these areas rather than try to reproduce the conditions under full-scale tests.

Dr. Hickox said that at the end of the CLPS discussion, it struck him that the typical landers being sent to the Moon will not be able to survive the lunar night. He wondered what that means for astrophysics applications, as it sounds like it would limit the utility of an astrophysics mission. Others agreed, and Dr. Woodward said it raises the question of the throwaway approach to the initial utilization of the Moon. Is the short duration activity worth it? And the clutter? Dr. Gaskin said that this surprised her and she wondered if it was a misstatement. The science community is absolutely planning for longer-duration projects. She would also like to see more synergy between the work of SMD and STMD on the development of some of these instruments. Dr. Conklin thought it was more of a lander issue, but he would like clarification. He believed that VIPER was going to power scientific instruments longer. He had the impression that the goal is to get scientific measurements on the surface quickly. That would call for testing to get the instruments landed at first, with less emphasis on actual measurement during the first couple of years, until there is more infrastructure and capability on the Moon.

Dr. Conklin also had the impression that planetary protection on the Moon is in the purview of Congress and international negotiation rather than under NASA, which has its own policies. He was further concerned about the age of Swift, which is important to multi-messenger astrophysics. Fermi is in a similar situation. Both have been on orbit a while, and it is not clear what will happen when there is no longer access to these missions. Dr. Hickox said that in regard to the archives, he was impressed by the level of use for the Swift light curve tool. That could be highlighted as an example of how to make data

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available for non-expert use. Dr. Gaskin expressed concern about the CubeSat selection numbers, and wondered how NASA could provide more knowledge to the community to open opportunities. The same is true with sounding rockets. They require additional expertise, and not all institutions have that. She wondered what NASA could do to provide the capability more broadly. She wanted to explore including BPS as well.

Dr. Meixner would like more on what NASA can support with balloons, and wants to know how the information will be shared with the community. She added that having mirrors on balloons sounds like brainstorming rather than something that has been vetted. Dr. Brenneman thought the response to the ADAP call was interesting and could be implemented in other programs. The NASA town halls on the process and the DAPR stood out as a great success. Dr. Woodward said they would make that a finding.

Wrap Up for Day 2

Dr. Meixner did not want to lose the point about reduction of science as a result of Covid-19. She also wanted to put in a statement of appreciation that NASA is supporting EC scientists.

Dr. Hasan thanked the visiting members of PAC and HPAC for their help with GPRAMA. Dr. Woodward noted that the next day would allow extensive public comment.

Adjourn

The meeting adjourned for the day at 4:57 p.m.

Wednesday, October 21

Opening Remarks

Dr. Hasan opened the meeting by reminding participants of the FACA requirements. All presentations are available to the public and all statements are on the record.

Dr. Woodward explained that this day was to focus on workforce issues, especially BIPOC participation at NASA. The goals are to create clear findings and recommendations to move APD forward to address inequities. He thanked the panelists and invitees for their thoughts and inputs to forward diversity within APD and asked those members of the community submitting comments to be guided by efforts toward positive change. APAC has a duty to seize the moment and act. In June, APAC forwarded to APD some findings and recommendations to consider, which will be addressed along with other germane activities in the Division. There was a portal for public comment as well as the WebEx chat. Dr. Moustakas added that the PAGs are another avenue for discussing the profession and priorities.

State of the Profession – Opening Remarks

Dr. Hertz thanked APAC for setting aside time to examine the state of the profession. It is clear that there is work to do at NASA and in the broader community. Inclusion is the newest core principle at NASA, and he is personally committed to a future where anyone can work, be funded by, and benefit from NASA efforts. He wants to be held accountable for that. There was a recent executive order on combatting race and sex stereotyping. NASA will comply, stressing unity of purpose and not divisiveness. The NASA workforce will be one where people can discuss experience and ideas, and the Agency has a unity campaign that emphasizes workforce engagement.

Diversity, Equity, Inclusion, and Accessibility (DEIA) is essential in APD and SMD. One of NASA's roles, especially at Headquarters, is to help advance the nation to achieve NASA science objectives. These objectives are hard, and in order to progress, the Agency will need the best researchers and other

talent that the nation has to offer. That requires inclusion. The science fields encompassed by NASA must be inclusive to attract the most capable researchers and, to that end, SMD has commissioned a NAS study to identify the barriers to the next generation of mission PIs. NASA and SMD are prioritizing DEIA both internally and for NASA-selected and -funded projects and teams. SMD has established internal groups, including the Anti-Racism Action Group (ARAG) and DEIA Working Group. In addition, SMD has enacted process changes such as DAPR, and is incorporating DEIA requirements and evaluation into AOs and ROSES.

Dr. Hertz then reviewed a chart with the DEIA-related APAC recommendations from the previous meeting, and the SMD and APAC responses:

1. *APAC requested a clear statement that APD values the well-being, lives, and contributions of BIPOC members of the community.* Both APD and SMD have made such statements.
2. *APAC sought an audit of institutional racism within the Division,* which has been initiated.
3. *APAC recommended that APD ensure BIPOC representation on the Committee,* which APD has done and will do in the future.
4. *APAC recommended that NASA consider including an evaluation criterion on promoting DEIA in all proposal reviews and directed work.* APD is adding this to AOs, and SMD is looking at it for ROSES calls.
5. *APAC recommended that APD assess current programs and initiatives directed toward DEIA, examine why these efforts have not been fully successful, and assess what fundamental changes are required to break exclusive and, specifically, racist structures within these.* Dr. Hertz said that this was to be discussed in more depth, but noted that a DEIA task force had been established with outside expertise added.
6. *APAC recommended that APD authorize the use of funds for Division and other personnel to participate in conferences organized to support BIPOC and other minority scientists.* As this is typically done at NASA Centers, APD has authorized Center management to take this step.
7. *APAC sought more avenues for community input,* which was being done.

In reviewing DEIA in APD and SMD, Dr. Hertz emphasized that it is important to keep supporting the careers of future leaders in the field despite the pandemic. There are challenges due to the differential impact across the community. SMD will soon release a call for proposals for EC and students for augmentations. He welcomed actionable recommendations.

Discussion

Dr. Woodward read a question from the public comment portal, about the criteria by which NASA will gauge its success in meeting these DEIA objectives. Dr. Hertz said that he would love to work with APAC on a quantitative response. The law restricts what demographic data NASA can collect, however. Therefore, community feedback is most important at the moment in letting SMD know where its policies and practices have a negative impact. He noted that advancing diversity and inclusion is part of his performance criteria. Dr. Strolger said that the task force might identify the first metrics and asked for more information about the group. Dr. Hertz replied that they meet weekly to examine APD and SMD practices and will make recommendations by the end of the year. Other divisions have similar groups working, so there may be multiple solutions. SMD leads ROSES changes, and the DAPR are already expanding.

Dr. Brenneman acknowledged the legal aspect of not acquiring demographic information, but wondered if there is a way to send a questionnaire to the community after proposal reviews to inform the discussion. Dr. Hertz replied that the Agency does collect that data on a voluntary basis from ROSES proposers. It is optional, collected by the Office of the Chief Scientist (OCS), which is still analyzing data. The prohibition on collection reflects a law that prevents the government from imposing additional paperwork. AAS has conducted censuses, and the DS has access to those data. SMD is asking for a NAS study to

identify the data needed to enable quality state-of-profession studies. SMD also wants NAS to address how to identify and get relief from impediments. If NAS tells Congress that NASA needs this, Congress will probably be responsive.

SMD Anti-Racism Action Group (ARAG) Update

Dr. Kartik Sheth explained that the SMD ARAG formed a few weeks before this meeting as a short-term group, with members from all SMD divisions except BPS, and he is co-Chair. It is important that they have well-defined outcomes. ARAG wants to be flexible in order to evolve as needed. The Group has spent time talking to colleagues anonymously, had workshops, etc., and has received roughly 200 ideas. They are now sorting those into three categories: quick wins, key levers, and long-term strategies. It is early, but ARAG will be presenting quick wins to SMD leadership. He gave some examples of the submitted ideas. In trying to determine what to tackle first, they are considering what SMD does well, what has been tried before without success, and what takes a longer and more complicated effort. If there is a “good idea” that has not worked, ARAG will look at the reasons for lack of success. Another key question is which successful programs can they join and amplify. It is also important to do this from the BIPOC perspective and not impose solutions.

Dr. Sheth gave some examples of end states. ARAG will communicate actions the group will undertake to SMD soon, asking individual SMD leaders to become champions for end states that SMD adopts. ARAG and the DEIA Working Group (WG) will coordinate on establishing a longer-term group and will identify next steps for actions that are longer-term ideas. There could be affinity groups, as well. Among other activities are: modifying AOs to align with NASA’s new core value of Inclusion; public statements by NASA and SMD leaders; an APD R&A task force on making the R&A process more inclusive; the audit previously mentioned, which will occur multiple times as part of a culture of evaluating programs; looking at the activities of other SMD divisions and advisory committees; and re-establishing the SMD Diversity and Inclusion Working Group.

In answer to a question, Dr. Sheth said that there is an external expert on equity working with ARAG. He does not have the OCS timeline for the demographic data analysis yet. He hopes the data will be a baseline that shows where SMD needs improvement and guides steps forward. Response bias has been discussed, as the data are voluntary. He suggested having OCS make a presentation at the next APAC meeting to discuss this. Dr. Meixner said that the PAGs would be interested in doing what they can. Dr. Sheth explained that he is always concerned about violating the paperwork reduction act, but analysis without surveys would be helpful. ARAG has more ideas than people and will take what help is offered.

Inclusive Partnerships with Indigenous Communities and the BIPOC Workforce

Dr. Aparna Venkatesan, a cosmologist at the University of San Francisco (USF), was the first panelist; she thanked NASA leadership for having the discussion. This year has brought us to an existential crossroads, with many crises, and this is all borne disproportionately by the BIPOC communities. It is important that NASA take on a leadership role in targeted ways with some of these crises. Among the points she made, Dr. Venkatesan emphasized the importance of identifying the stakeholders who should be making decisions about NASA’s future but are not at the table. It is also crucial to translate NASA’s mission and values to diverse excellence in NASA’s future workforce, and greater mission success. The Agency must honor that some communities have a long on-ramp to joining its workforce.

She spoke of targeted solutions: funding for the EC workforce, increased support for bridge programs and nontraditional students, and recognition of the impact of the pandemic. The digital divide has become the digital chasm, yet access to broadband is a necessity. These needs will not end with the pandemic. One suggestion was to fund long-term relationship building and initiatives, avoiding last-minute DEIA partnerships that make proposals look more inclusive than they are. NASA should review the reviewers, and review the repeat applicants for whom an award would be a game-changer for their institution and

community. Do grants go to the same places repeatedly? In order to transform its culture, NASA needs to recognize that science outcomes are inseparable from scientists, reject divisive dualities (science vs. culture) and siloed thinking, move to true long-term thinking, reward models of inclusive leadership, and lead by establishing a Cultural Ethics/Protocol Office that will include indigenous communities. Space has many stakeholders despite the emphasis some place on the interests of investors and the private sector. Dr. Venkatesan pointed out the importance of advocating for dark skies and ancestral points of view rather than engaging in a claim to ownership and occupation of space. She noted that our ancestors were all scientists and explorers, and NASA should strive to learn from all traditions to maximize mission success. We need to think about what we might lose otherwise, and envision what future scientists and storytellers say about what we did and did not do at this juncture in our collective history. She recommended that APAC do this event again in a few months.

Dr. Lucianne Walkowicz thanked Dr. Venkatesan. A lot of what she said ties back to APAC's discussion of the urgent need to examine planetary protection protocols in context of the Artemis campaign. NASA should have a more thorough discussion of the Artemis activities related to sustainability and disposability. Dr. Hickox said he was pleased to see the point about rejecting the contrast between science and culture, and allowing people to be their full selves. It is increasingly difficult online, but he wondered about activities to encourage this. Dr. Venkatesan said that there are resources at Indigenous institutions that she would share. It is important to fund initiatives rooted in the communities so they can state their needs and involve their youth in the science. Dr. Mahadevan said that we are losing the night sky, and although there has been some response from NSF, it has been tame and circumscribed. The broader concern is that we are losing something the species has had for millennia. He wondered if NASA should engage on this, and if not, who should. Dr. Venkatesan said that this has been a year of crises, and the loss of dark sky has been subsumed within that. AAS has an effort on this, but it is another siloing. SpaceX is taking some steps to partner and cooperate, but other players are international. It would be welcome to integrate this into NASA's cultural protocol.

Finishing the Job: Graduate Education and the NASA Workforce

Dr. Marcel Agüeros discussed NASA's reliance on universities for workforce training. A graph of the number of PhDs earned by Hispanic and Black Americans showed that these degrees do not reflect overall or student demographics. A 2018 AAS task force on diversity and equity in graduate education recognized the need for outside experts and included social scientists as advisors. The first recommendation from the task force report was to partner and recruit from programs that produce large numbers of graduates from underrepresented groups, and NASA should be able to do this. Dr. Agüeros noted an effort by the American Institute of Physics (AIP) to increase the number of Black students earning undergraduate degrees in physics and astronomy. A major point of that report is that this requires that we think differently and address issues within our culture. A graphic presented tools to use to assess whether and how an organization is changing its culture.

Dr. Agüeros discussed his own experience as a grad student interacting with NASA from 2003 to 2006. He received the Dr. Harriet G. Jenkins Predoctoral Fellowship (Jenkins Fellowship), named for a Black administrator who worked to integrate NASA. The Jenkins Fellows from his cohort have gone on to become quite accomplished. Unfortunately, the Jenkins Fellowships no longer exist, and NASA has not made the progress it should. If we want a different conversation on this topic in 10 years, we need to act now.

Dr. Strolger said that NASA might also hold the community's feet to the fire in evaluating education and efficacy. Dr. Agüeros said that NASA is a place where top-down decision-making still matters, which is very different from the university environment, where some of the limits of bottom-up efforts to address diversity have been reached. It is a dialogue. Federal agencies can require proposers to state how they will address DEAI.

Advancing Inclusion

Dr. Dara Norman began by stating that her presentation represented her own opinions. There are various ways to think about cultural systemic change in this field. Astronomers are good at recognition and informal collaboration, but for cultural change, they need formal institutional change. This is where the agencies come in, to incentivize inclusion and create consequences for not embracing this change. It is essential to harness innovation through inclusion of the diverse workforce. In formal institutional change, there are two kinds of access: advisory committees and resources. Too often, science leadership comes from narrow groups whose members have little or no experience with barriers. We need to include experience and expertise to bring in that experience of the many types of barriers, including personal, institutional, and career phase obstacles. There is a burden on minorities to represent their demographics, and while we value their presence, we should also reach out to networks to bring in ideas and perspectives.

Resource access is a way to move marginalized and underrepresented groups to achieve insider status. A plot showing publication related to Hubble, direct time, and archival work shows that for those at smaller institutions, the archival work is much more important to getting published. This is an issue, as archives are not sufficient for achieving insider status. People need opportunities and tools to use the data and gain insider status. All policies have pros and cons; Dr. Norman used Open Skies and DAPR as examples. She reached out to colleagues at smaller institutions to ask what they need to participate on large missions. They said they need policies and procedures that offer mutual benefit, opportunities for networking and collaboration, enabling infrastructure, and training on platforms and tools. This goes all the way through a career, beyond students and ECs scientists into mid-career. We have to be deliberate in how we embrace DEIA, and review policies continually.

Dr. Woodward observed that with the currency of publication to gain insider status, there is the necessity of mentorship. Dr. Norman agreed that mentorship is important, but there has been a lot of focus on the pipeline and we still have not gotten it right. We also need to focus on retention, and mid-career training can enable those individuals to mentor EC people. The mid-career people need time, and a way to enter these opportunities along with their students.

Discussion

Dr. Woodward wanted to capture both APAC discussion and public comment in this session. Dr. Strolger said that there is a need for the tools that go along with archives and higher level learning, so people are less dependent on their institutions. Dr. Gaskin said it can still be intimidating. Dr. Walkowicz wondered if these might dovetail with proposal workshops, and making sure people can propose to new data. Dr. Strolger agreed, stating that there is a need to teach the teachers. Dr. Norman said that workshops are often held at times and places that are not convenient. She would want the people who develop the tools to visit these smaller institutions and actually see how they operate with the resources. Dr. Sheth described workshops he did with individual institutions; it improves the relationships and understanding. It is not enough to introduce tools and data and stop there.

Dr. Woodward read a question from the portal, about NASA's stance on introducing quotas in fellowship programs to improve representation of underrepresented groups. Dr. Hertz explained that NASA cannot legally set quotas. SMD is consulting with social scientists, like the contractors from LMI. Dr. Galeazzi said that there is the problem of the burden on the minority members who are put on all these panels and have less time for their own work. Dr. Norman said that it would help to have more people from underrepresented groups in the field, but in the interim, advisory committees need to reach out to their networks for perspectives, including students and postdocs. Dr. Sheth noted that ARAG is aware of this pressure. Dr. Walkowicz said that it might be helpful to the community to see how NASA selected the ARAG partners and the criteria. There are organizations that would like to change but struggle with

finding appropriate partners. They then seek help from internal minority members to help fix the department when those people are there to do astronomy. Dr. Hertz said that he did not know how LMI was selected; the process can be shared if requested, but it comes via the Federal contracting process.

Dr. Evan Scannapieco said that the APD R&A DEIA Task Force has only been in existence for about a month and this meeting was one of the first efforts to get input. They have made progress in identifying some of the desired outcomes. These include: receiving more proposals from individuals in underrepresented groups; achieving a commensurate selection rate; improving inclusivity on teams so that people of all backgrounds feel valued; enhance training of a broader range of future proposers; taking appropriate actions to root out toxic behaviors; and bringing in and training more researchers from institutions not often represented in the pool of applicants. He looks forward to further input and asked that people please contact him with further thoughts.

Dr. Venkatesan added that she loved the discussion about being an insider and the long-term output from archival data. She reiterated the need for longer-term grants and partnerships. There is a need to reach the communities rather than expect them to come forward. Many departments do not have the basic resources, and seeing what they have is incredibly helpful. In terms of rewarding the demographically stressed EC scientists, NASA should honor their contributions through funding; it should also be part of their professional evaluations. Part of looking out for them is enabling them to have the time for self-care.

Dr. Bautista said that the discussion of academic departments assumes they are all very similar to each other, but there are structural differences by size and whether they serve underrepresented students. The success rate can be a disincentive to propose. Dr. Hickox said that for representation on committees and panels, funding is important at every level. A lot of the work is done without compensation. He asked if NASA programs have the scope to fund where it can have more impact. Dr. Hertz said that NASA does have the tools to compensate. Some review panels, such as those to down-select Explorers, are done on a consulting status. The question is the community standard. Is being a peer reviewer part of being a scientist? The money would have to come from somewhere. Dr. Norman said that there is no need to pay everyone, but there are perspectives that will be missed unless people are paid for their time and expertise.

Dr. Woodward read two more questions from the portal, these having to do with communication and engagement. First, how were the DEIA working group activities being shared to the wider community outside of SMD? And second, what efforts would be made to share this APAC discussion with other advisory committees? Dr. Hertz said that this discussion will be shared with SMD. Dr. Sheth added that ARAG is trying to ensure that they do not reinvent the wheel in each discipline; they are doing cross-division teams. They are also going with internal ideas first for a number of reasons, one being relative ease of implementation. Dr. Bautista said that NASA has a deep impact on culture and ethics, and ethics has a deep impact on diversity. It is less about counting than having a range of POVs. Dr. Venkatesan said that researchers want science outcomes that surprise them. She noted some of the partnerships and outcomes from work in Hawaii.

Dr. Woodward read a question from the portal: "What role do NASA postdoctoral programs and fellowships play in addressing systemic inequities and improving diversity, equity, and inclusion in astrophysics? How do these programs currently address NASA's objectives in Inclusion and how is this assessed?" Dr. Hertz said that the fellowships have been completely about science merit and professional potential. Inclusion is a new value and has not yet been included. Another question from the portal was about a proposal writing workshop given at GSFC, which should help minority EC scientists. While the information is welcome, smaller universities often lack the infrastructure to help produce competitive proposals. How can NASA help develop that infrastructure where it may be lacking? This relates to the efficacy of current programs. Dr. Sheth replied that in a discussion of solicitations from Headquarters,

ARAG broke up into groups and has established relationships, and is engaged in follow-up. ARAG is trying to do more regional workshops done regularly for long-term partnerships but is not at that step yet for infrastructure. They are working on inclusivity language for the AOs.

Dr. Agüeros noted that there have been NASA fellowship programs that pulled in minority-serving institutions, and these were highly successful but were eliminated in 2010. Dr. Meyer said that other programs were killed that same year presumably due to budget issues, and NASA must be careful not to do that again. Dr. Gaskin spoke to the need for information when a proposal is not selected, and called for rigorous debriefing. Dr. Sheth agreed, adding that he heard a common complaint from smaller institutions about the lack of true long-term development in some programs.

Another question from the portal was: “Many [NASA Hubble Fellowship Program (NHFP)] fellows have expressed a desire to use a portion of their research funds for outreach and mentorship efforts at their host institutions; however, such a policy would disproportionately disadvantage minoritized fellows by taking resources away from activities that aid in career advancement. Is there a source of funding available to support outreach efforts (especially those that benefit young BIPOC) by NASA-funded scientists? If not, would NASA administrators be willing to discuss how these outreach efforts could be financially supported?” Dr. Hertz replied that NASA is willing to consider whether and how to do such things. He noted that NASA grants are for science research. Outreach programs were explicitly deleted from the NASA budget and he can only fund what is in the appropriation. Dr. Sheth added that Hubble fellows are allowed to use funds in mentoring students.

Dr. Woodward then read a question from the chat, asking how NASA can expand access to opportunities to work on the Agency’s hardware opportunities. Dr. Hertz said that some of the hardware efforts are more like apprenticeships. NASA is trying to make sure that missions are inclusive so everyone has that kind of opportunity. There are also technology fellowships for EC people, and balloon and sounding rocket programs include training. Dr. Norman said that an issue is the perpetuation of advantage for people who have had missions. Inclusivity needs to be a criterion for awards, with incentives for bringing in people from other groups. There also needs to be assessments as to whether they are actually doing the work past just the proposal. Dr. Hertz agreed. He expects this to happen because he is hearing it from the group working on this. Dr. Venkatesan said that grants, prizes, etc. are privileges, and they can accumulate in certain institutions. It then becomes hard for other people to become insiders. This needs to be honored through compensation and a way to overcome the systemic hurdles. Long-term partnerships are one of the solutions.

Another question noted that this APAC meeting was occurring at the same time as the annual conference of the Society for Advancement of Chicanos/Hispanics & Native Americans in Science (SACNAS), and the timing was poor, as it excluded non-White scientists. Dr. Woodward said that this was unfortunate indeed, but this particular schedule was unavoidable due to APAC member conflicts. He apologized and said that there would be more care taken in the future. Dr. Walkowicz added that APAC should also stop considering the Jewish holidays as potential meeting days. Dr. Conklin said that APAC had previously discussed having EC people on the Committee, but the level of expertise needed precludes that. However, there may be creative ways to amplify EC voices to the APAC through PAGs or a postdoc representative. Dr. Woodward said that this would be discussed.

Gaps RFI Update

Dr. Sheth said that he has been working on DEIA for 2.5 decades and has not previously encountered seen this kind of energy and enthusiasm. SMD Associate Administrator Dr. Thomas Zurbuchen has an incredible commitment to this, and Dr. Hertz is a superstar.

Almost a year ago, SMD issued an RFI on ROSES gaps, which Dr. Sheth discussed now. There were 97 responses, 24 percent with female names. NASA Centers made up almost half of the responders, academia 21 percent, labs not quite one third, and there was one minority-serving institution (MSI). Responses covered the breadth of SMD-supported disciplines, and addressed science, technology, and other capabilities. The responses fell into five major themes:

1. Gaps in existing SMD research programs
2. Technology development
3. Data science, algorithms, software
4. Ground-based observations
5. Data archives

Many responses raised points that SMD recognizes and for which there were already internal actions underway. There are no decisions made from this work yet, as the pandemic has overwhelmed the capacity to address it. As a result, Dr. Sheth could promise only that he would have more information at a future APAC meeting.

The finding under the first theme 1 (F1) states that some research projects are inherently short-term and therefore not the highest priority in SMD divisions. Others fall between siloes and may warrant interagency partnerships. The action is to add a checkbox on the proposal cover page, with space for an explanatory paragraph, so that proposers can flag interdivisional research. Program officers will use the information to ensure an appropriate review for these proposals. SMD will analyze the data over two ROSES cycles, report back to the community, and adjust the strategy as needed. Dr. Sheth noted that SMD does not want to be prescriptive with the program officers.

F2 calls for better coordination of technology development across disciplines. In response, the SMD Chief Technologist will hold a Technology Festival in early 2021 to promote better awareness of the investments and opportunities for cross-divisional technologies in SMD and STMD, and to foster better coordination and exchange of ideas across the community. In mid-2021, TechFed will publish its gaps list, which is in progress. Dr. Sheth said that it is not clear whether the issue is awareness or access. Also, TechFed agrees that low TRL (1-3) technologies could be developed and managed in a cross-cutting fashion and is studying the funding of the various TRLs. That report will be available in the first quarter of 2022. There is some brainstorming going on in regard to the TechFest.

F3 seeks better sharing of data science techniques and algorithms across SMD for more efficient missions and data mining. SMD has a Science Data Management Working Group (SDMWG) and a new Science Data Officer investigating this. The WG is laying out an SMD-wide policy to require all proposals to archive and make publicly available all software generated by SMD funded research. This builds on previous work by ESD. Dr. Hertz added that ESD coordinates use of NASA computing facilities, while this group is about policies. APD is already implementing these policies and looking at ways to make Webb and Roman data accessible to the community. Dr. Woodward asked about the dual use aspect of open software code and national security concerns. There were some fuzzy areas regarding export control and science data. Dr. Hertz said there was some experience with dual use and instrumentation, but the software issue was new to him. Dr. Sheth said he would find out more.

Dr. Strolger wondered about the extent the changes to ADAP and ATP would actually fit proposer interests. His understanding that many theorists believe they develop longstanding tools that keep getting further developed as they progress to larger and more complex data sets. He wonders if making earlier versions of that code might be counterproductive to their career development. Dr. Hertz said that there are requirements that the output of all federally funded research be made public, and there is a NAS report recommending that NASA establish policies for open code. The Agency is still working on implementing these requirements and recommendations. There is always the need to review whether it is worth the

effort of making something public. If something is preliminary and has not been vetted through peer review, that could be part of the decision process. Dr. Walkowicz noted that whether it is advantageous or detrimental to someone's career progress is heavily dependent on subfields; she gave some examples. Overall, the field has moved toward open source code. It is less about an individual being tied to the usage and more towards that person being recognized as a developer of astronomical tools. There are arguments on both sides.

Dr. Sheth resumed his presentation. F4 cites a community desire for NASA to make larger investments in ground-based items. SMD has plans to clarify existing flexibilities in AOs, which allow for costs of mission-essential ground-based work. SMD will also clarify existing opportunities and flexibilities in R&A as well as the role of other agencies with the community. This information will be reported out at town halls. SDM will consider the best ways to link relevant databases resulting from laboratory research that may be useful across divisions.

F5 asks NASA to review and build more holistic archives, with appropriate policies for initiating, maintaining, and sunseting archives. The working group is looking at this, and SMD is establishing a data catalog to make all data discoverable. It will take 2 or 3 years to implement this on a large scale. Dr. Bautista said that there are issues arising from NASA's lack of a cloud environment, and some of this is quite urgent. Dr. Sheth said that ESD has signed an agreement to have cloud services across SMD; this should be publicized more, however. It was noted that this connects to the earlier discussion about accessibility and training for broader communities NASA wants to enable; this should be in the working group's charge.

Discussion

Dr. Woodward reviewed some of the unaddressed questions in the portal. One asked about APD and SMD plans to reach parity. Dr. Hertz said that it is a goal but there is no action plan at this point. Next, Dr. Woodward read: "Anecdotally, the NHFP fellows are not a diverse group, but there is no demographic data gathered for previous NHFP applicants and awardees and hence it is difficult to evaluate this. On the other hand, demographic data is gathered for other awards through NSPIRES. How is NSPIRES demographic data being used and what has been learned from it? Will NASA in the future also collect and publish demographic data for fellowship programs?" Dr. Hertz said that there is ongoing analysis pertaining to the executive order, and NASA will make adjustments if needed. In response to another comment, he pointed out that grantees are not contractors.

Dr. Hickox said that the PAGs have talked about making data analysis tools more useful for those who are not quite expert. He would like to think about tasking the PAGs or a SAG to think about how this work can best be done and how making data and codes public could be valuable to the community. Obtaining access can be intimidating at first, but groups that did not have much experience in these areas have shared their experiences via published papers. It could be useful for those wanting to do research to see these papers or otherwise learn how the authors gained access in order to get a picture of how the research was carried forward.

Dr. Walkowicz said that she had received a communication from a NASA center employee saying that they are being instructed not to discuss implicit bias. Dr. Hertz said that he had not heard that. The Agency was still analyzing the Executive Order and had not determined what it did and did not cover, nor was there a process to decide that. An abundance of caution has led SMD to stop implicit bias training at the peer review panels, however.

Dr. Meyer said that until they know what the computing review finds, it was not clear how APAC could contribute. Dr. Woodward agreed; that topic will be on the schedule for the next meeting. Dr. Hertz said that a draft policy will be briefed to APAC, then to the community. Dr. Woodward suggested that the

PAGs consider how to implement these things, perhaps via a SAG. Dr. Hertz explained that APAC should not do non-value-added work. This was covered by NAS. Dr. Mahadevan wanted APAC to make a statement on the proposed Department of Homeland Security restrictions on foreign student visas. Dr. Hertz said that APAC advises APD. Members of the community express their views via other pathways.

Dr. Woodward asked for topics to highlight as findings or recommendations. Dr. Holley-Bockelmann asked that all future presentations include a slide on how they are addressing inclusion. It would further integrate this value into NASA. Dr. Woodward said that the long-term fidelity of the archives and datasets has been mentioned before, but he would like for APAC to think about that again. Dr. Meyer asked to have the XRP selection rate when it is available. They had discussed making opportunities to use science instruments on rockets and balloons more accessible. It is hard to compete for those who are not experts, but they might have an instrument that could fit on one of those platforms. Dr. Woodward wondered if there is a common bus so that groups can focus on science instrumentation. Dr. Suvrath thought NASA should help more with the buses on the CubeSat program, suggesting that the Agency might be asking too much of new PIs to manage the bus as well.

Dr. Woodward asked how the Artemis CLPS architecture fits into the SMD/STMD discussion of technology. He wondered if any of the shared technologies involved in CLPS might enable APD missions to be more rapidly brought forward. Dr. Hertz said that the technologies need not be linked to CLPS. The question is how to identify the technologies you want to mature, and how to mature them rapidly. The capability to survive the lunar night is being developed, with the first applications to be on robotic missions. After that, they will become available to everyone. Dr. Hickox observed that on TESS and Swift, much of the science is not from the prime science driver. That is a testament to both mission design and the creativity of the community. He would like that kind of information for other missions. Dr. Hertz said that this is a major element of each SR and is in the documentation.

Dr. Moustakas said that he liked the ExoPAG effort to offer stipends and wondered if other program offices and PAGs might consider this. Dr. Conklin agreed and explained that the other program offices do hold some travel funds that could go to support this. Dr. Moustakas added that Dr. Meixner's personal statement was eloquent and he would like to subscribe to it as well. Like her, he wants to be held accountable. The desire and willingness to be open is important. He is excited for the journey and was grateful for this day. Dr. Woodward said that APAC as a whole will be held to the standard that Drs. Meixner and Hertz articulated. This will be a partnership, and it is APAC's remand to bring this aspect of its engagement forward.

Dr. Meyer thanked the invited panelists and said that those presentations were wonderful. He also thanked Dr. Woodward for his leadership in this discussion. Dr. Woodward gave credit to APAC and APD. He raised the issue of Hubble's likely future. Dr. Hertz said that NASA will operate Hubble as long as it is scientifically productive. The SRs for Hubble discuss how to use it better, and STScI focuses on doing the most important work first. Dr. Walkowicz thanked the speakers and said it was wonderful to have spent this time, which she hopes they will do regularly. It is a long process.

Dr. Bautista was concerned about what happens to NASA's UV capabilities when Hubble ends. Dr. Hertz replied that several missions before the DS propose UV work, both flagships and probes. APD will follow the DS. Dr. Woodward asked about the larger aperture telescopes on balloons, and Dr. Hertz said that there is a concept study going on now. Dr. Sheth elaborated: the team for that is funding a project that is looking at refllyable mirrors. Balloons are increasingly expensive, so being able to streamline them would be helpful. Dr. Woodward noted the search for alternative sites. He would like an update on how that process is moving along, and more information on sounding rockets as well. Dr. Gaskin urged caution on refllyable telescopes, as there are community needs to be met and this could focus on a specific wavelength. Sounding rockets are tied into making resources available to the larger community. It can be

hard to know how to partner and make these opportunities available across the board to smaller institutions, but there has to be a way. Dr. Strolger pointed out that everyone has a different hurdle for the next step. It might be fear of competition, or not knowing who you can partner with. There might not be enough information, or an overwhelming glut. Dr. Meixner thought Dr. Hertz had suggested that missions were going to be required to have more diverse teams, which may be needed on sounding rockets and balloons. Some investigators might not know where to reach out to partner. She wondered if NASA could facilitate the matching process. Dr. Hertz said that SMD is not requiring people to partner or have quotas. They are looking at ensuring that projects reflect DEIA, but will not require partnering.

Dr. Moustakas observed that the APAC charge is to advise APD. The concerns they discussed were broader, and he wondered if there might be a way to share with the groups advising some of the other entities. Dr. Woodward asked if NASA is using the Launchpad opportunity and following those cohorts, if that constitutes a natural engagement point. What is the effectiveness of the current programs and are they achieving the desired goals? If the models are effective, how does NASA emulate them, and how is triage done? He would like APAC to continue this dialogue. The DS will make observations and recommendations as well, and APAC will work with Dr. Hertz. He thanked all of the panelists for their very thoughtful discussions.

Brief to Division Director

Dr. Woodward pointed out that the discussion was a rolling brief.

He thanked the outgoing members of the Committee: Drs. Moustakas, Brenneman, Conklin, and Galeazzi. Their contributions have been beneficial and welcome.

These days were illuminating. He thanked Dr. Hertz for the response to the last letter, as well as many great things done under his leadership of APD. The mission updates were helpful. He hopes they will have the DS by the next meeting. He also appreciated all the participation.

Dr. Hasan thanked the APAC members and the speakers, especially the outgoing members. She welcomed the new members and thanked them for their contributions. Two members will rotate off in September 2021, and APD will need new names for those slots. She planned to send out a poll to find dates for the spring meeting. Dr. Hertz noted that he does not know when the DS will come out; Dr. Woodward said they would find a time and see what happens. Dr. Conklin was interested in reactions to the 3-day format. Dr. Woodward thought the Committee would get more done in person eventually. It is a large amount of time, but they want to be thorough.

Dr. Hertz thanked everyone, including the departing members. APAC should not be surprised when APD is responsive because the advice is thoughtful and actionable. Dr. Hasan added that APAC has always been a leader in doing new things like this 3-day virtual meeting.

Adjourn

Dr. Woodward urged everyone to stay well and adjourned the meeting at 3:56 p.m.

Appendix A Participants

Committee members

Charles Woodward, University of Minnesota, *Chair, Astrophysics Advisory Committee*
Manuel Bautista, University of West Michigan
Laura Brenneman, Smithsonian Astrophysical Observatory
John Conklin, University of Florida
Massimiliano Galeazzi, University of Miami
Jessica Gaskin, NASA Marshall Space Flight Center
Ryan Hickox, Dartmouth College
Kelly Holley-Bockelmann, Vanderbilt University
Suvrath Mahadevan, Penn State
Margaret Meixner, Stratospheric Observatory for Infrared Astronomy Science Operations Center/USRA
Michael R. Meyer, University of Michigan
Leonidas Moustakas, NASA JPL
Louis Strolger, Space Telescope Science Institute
Lucianne Walkowicz, Adler Planetarium

NASA

Paul Hertz, NASA HQ, *Director, Astrophysics Division*
Hashima Hasan, NASA HQ, *Executive Secretary, APAC*
Lorella Angelini
Gary Blackwood, JPL
Patricia Boyd, GSFC
Lucien Cox
Elinor Davis
Elaine Denning
Dan Evans
Mike Fanelli, NASA Ames
Ingrid Farrell
Johnathan Gardner
Stefan Immler
Jennifer Kearns
Carolyn Kierans, GSFC
David Leisawitz, GSFC
Michael New
Mario Perez
Thai Pham, GSFC
Graca Rocha, JPL
Rita Sambruna
Evan Scannapieco
Kartik Sheth
Eric Smith
Erin Smith
Linda Sparke
Karl Stapelfeldt, JPL
Amber Straughn, GSFC
Jennifer Wiseman

Non-NASA/Unknown

Marcel Agüeros, Columbia University
Adriana Apolito-Bevis
Sam Badman
Tom Barclay
Jillian Bellovary
Tyler Bourke
John Chisholm
Alison Coil
Abby Crites
Thankful Cromartie
W. D'Arcy Kenworthy
Tammy Dickinson
Serina Diniega
Sylvie Espinasse, European Space Agency
Deborah Fairbrother
Bridget Falck
Mark Fonda
David Gaba, Stanford
Lisbeth Gavilan
Jonathan Gardner
Barbara Giles
Lindsay Glesener
Paul Goldsmith
Yilen Gomez Maqueo Chew
Tom Greene
Shahid Habib
Jeffery Hollingsworth
Grace Hu, OMB
Sicong Huang
John Huleis
Teresa Jensen, Space Dynamics Laboratory
David Jones
Kelsie Krafton, American Astronomical Society
Peter Kurczynski
Aleksandra Kuznetsova
Sara Lipscey, Ball Aerospace
James Lochner, USRA
Nicole Lloyd-Ronning
Sangeeta Malhotra
Eric Mamajek
Yao-Yuan Mao
Charlotte Mason
Stephan McCandliss, JHU
Julie McGeoch
Roberto Moncada
Dara Norman, NOIRLab
Christine O'Donnell
Tuvijaat Pandey
Parvathy Prem

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Alex Pope
Aryan Raj
William Reach
Andrew Rowe
Kate Rowlands
Kirby Runyon
Ryan Sanders
Wilton Sanders
Liza Sazonova
Elizabeth Sheley, Electrosoft
Alan Smale
Keivan Stassun
Harvey Tananbaum
Johanna Teske
Todd Veach
Laura Vega
Aparna Venkatesan, University of San Francisco
Sarah Vines
Stuart Vogel, University of Maryland
Debra Wallace
Paula Wamsley
Ashley Wilkins, House Science Committee
Maurice Wilson
Lei Zhai

Appendix B
Astrophysics Advisory Committee Members

Charles Woodward, APAC Chair
University of Minnesota

Hashima Hasan, Executive Secretary
Astrophysics Division
Science Mission Directorate
NASA Headquarters

Manuel Bautista
University of West Michigan

Laura Brenneman
Harvard University

John Conklin
University of Florida

Massimiliano Galeazzi
University of Miami

Jessica Gaskin
Marshall Space Flight Center

Ryan Hickox
Dartmouth College

Kelly Holley-Bockelmann
Vanderbilt University

Suvrath Mahadevan
Pennsylvania State

Margaret Meixner
Stratospheric Observatory for Infrared Astronomy Science Operations Center/USRA

Michael R. Meyer
University of Michigan

Leonidas Moustakas
Jet Propulsion Lab

Louis Strolger
Space Telescope Science Institute

Lucianne Walkowicz
Adler Planetarium

Appendix C
Presentations

1. *Astrophysics Division Update*, Paul Hertz
2. *Webb Telescope Update*, Eric Smith
3. *Astrophysics CubeSat Missions Update*, Michael Garcia
4. *Halosat Update*, Phil Kaaret
5. *Biological and Physical Science Division Update*, Craig Kundrot
6. *Balloon Roadmap Update*, Peter Gorham
7. *Astrophysics Sounding Rocket Missions Update*, Thomas Hams
8. *PhysPAG Report*, Graca Rocha
9. *Artemis CLPS/Astrophysics Payloads Update*, Dave Burns
10. *TESS Update*, Patricia Boyd
11. *Swift Update*, Brad Cenko
12. *COPAG Report*, Margaret Meixner
13. *ExoPAG Report*, Michael Meyer
14. *ISFM Update*, Dan Evans
15. *GPRAMA Process Overview*, Jennifer Kearns
16. *State of Profession – Opening Remarks*, Paul Hertz
17. *SMD Anti-Racism Action Group Update*, Kartik Sheth
18. *Inclusive Partnerships with Indigenous Communities and the BIPOC Workforce*, Aparna Venkatesan
19. *Finishing the Job: Graduate Education and the NASA Workforce*, Marcel Agüeros
20. *Advancing Inclusion*, Dara Norman
21. *Gaps RFI Update*, Kartik Sheth

**Appendix D
Agenda**

**Astrophysics Advisory Committee
Virtual
October 19-21, 2020**

Monday 19 October

11:00 a.m.	Introduction and Announcements	Hashima Hasan/Charles Woodward
11:10 a.m.	Astrophysics Division Update	Paul Hertz
1:10 p.m.	Webb Telescope Update	Eric Smith
1:30 p.m.	Astrophysics CubeSat Missions Update	Michael Garcia
1:45 p.m.	Halosat Update	Phil Kaaret
2:00 p.m.	Break	
2:15 p.m.	Biological and Physical Science Division Update	Craig Kundrot
2:45 p.m.	Balloon Roadmap Update	Peter Gorham
3:30 p.m.	Astrophysics Sounding Rocket Missions Update	Thomas Hams
4:00 p.m.	PhysPAG Update	Graca Rocha
4:20 p.m.	Public Comment Period	
4:30 p.m.	Discussion	APAC members
5:00 p.m.	Wrap up for Day 1	Charles Woodward

Tuesday 20 October

11:00 a.m.	Opening Remarks	Hashima Hasan/Charles Woodward
11:10 a.m.	Artemis CLPS/Astrophysics Payloads Update	Dave Burns
11:40 a.m.	TESS Update	Patricia Boyd
12:05 p.m.	Swift Update	Brad Cenko
12:30 p.m.	Exoplanet Research Program	Pamela Marcum
12:55 p.m.	COPAG/ExoPAG Updates	Margaret Meixner/Michael Meyer
1:35 p.m.	Public Comment Period	
1:40 p.m.	Break	
2:00 p.m.	ISFM Update	Dan Evans
2:20 p.m.	GPRAMA Process Overview	Jennifer Kearns
2:30 p.m.	GPRAMA Discussion	APAC members
4:00 p.m.	Discussion	APAC members
4:55 p.m.	Wrap up for Day 2	Charles Woodward
5:00 p.m.	Adjourn	

Wednesday 21 October

11:00 a.m.	Opening Remarks	Hashima Hasan/Charles Woodward
11:10 a.m.	State of Profession – Opening Remarks	Paul Hertz
11:25 a.m.	SMD Anti-Racism Action Group Update	Kartik Sheth
11:40 a.m.	Inclusive Partnerships with Indigenous Communities and the BIPOC Workforce	Aparna Venkatesan

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11:55 p.m.	Finishing the Job: Graduate Education and the NASA Workforce	Marcel Agüeros
12:10 p.m.	Advancing Inclusion	Dara Norman
12:25 p.m.	Discussion	APAC members
1:00 p.m.	Public Comment Period	
2:00 p.m.	Break	
2:15 p.m.	Gaps RFI Update	Kartik Sheth
2:35 p.m.	Discussion	APAC members
3:30 p.m.	Recommendations, Actions	Charles Woodward
3:45 p.m.	Brief to Division Director	
4:00 p.m.	Adjourn	